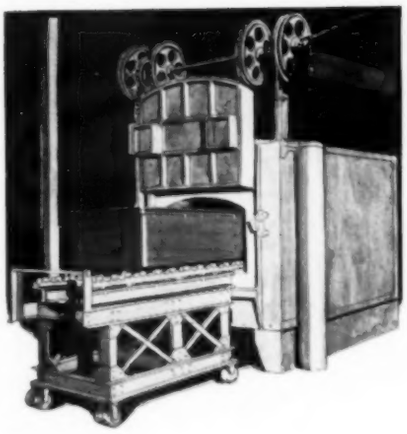


THE FOUNDRY

for September

NRA Encounters BACKLASH

EVERY angler sometime encounters an annoying snarl when the cast over reaches and the restraining thumb fails to check the backlash in the line. Such a snarl apparently has encompassed NRA. Pleading precipitate haste to codify all industry within a definite time limit fails to excuse the present tangle. The restraining thumb of the administration has failed to stop the whirring reel. The tangled cross lines of zeal for reform, delay, indecision, exceptions and timorous enforcement have produced a backlash.

It is unfortunate that a program, originally advanced for the purpose of increasing employment and abolishing destructive competition, should have gone so far astray. At the start the function of government in the heralded partnership was that of judge or referee. Labor and management were expected to work out their own problems and adjust their differences. Management was slow in finding voice, and industry found in only a few instances, surcease from ailments of cut price and vicious chiseling.

In general the deputy administrators at the start were qualified to play their part and some beneficial codes were evolved. As the work advanced changing personnel brought changing policies and practices. A few officials, perhaps forerunners of succeeding ranks of deputies and assistants, became advocates of certain social theories; others suffered the expanding ego of brief authority. New angles were interjected by politicians, by statisticians, professional economists and self annointed apostles of that mythical deity, the consumer. Consequent tampering, revision of recognized procedure, reversals of rulings which fall little short of bad faith have brought the backlash. A basis of mutual trust and co-operation through common interest has been undermined by meddling.

The lot of those who have accepted responsibility upon industry code authorities has not been happy. Quibbling over "recognition," delays in authorizing assessments for code administration and the constant unloading of extraneous mandatory provisions, tricky, power stealing by-laws and regulations, not contemplated in the original plan, have made the duties of code authority members unpleasant and wasteful of time and money. Handling of hearings on amendments, shown to be necessary for the very salvation of some industries, has been abominable Additional afterthoughts and new provisions are thrust at code authorities seeking such amendments and arbitrary changes emasculating the original contracts with NRA are frequently imposed. Bad faith on the part of NRA is a natural charge arising in the minds of many code authority members.

Prompt acknowledgement of questions raised with NRA is customary, but here speed ceases. Reference to this and that division for ruling, buck passing on compliance action, and untenable pronouncements from legal oracles tangle the skein. Fleeting time is tripped, impeded and smothered in official delays. Codes pronounced in effect last winter have just this fall reached the stage of practical application of all provisions.

Changes in the structure and operation of the whole program is needed. Some feelers have been thrown out as to the nature of the changes contemplated. The organization of industry under codes has gone so far that it is difficult to contemplate discarding them entirely. The first step in any contemplated revision should not be made unless industry, and by industry we mean the owners of businesses and managers who must meet the payrolls, are consulted. No mock conference like that of last March will suffice. Two must talk to make a conference and if the code authorities said anything last Spring it was only through faint applause, when NRA officials ceased their ample orations.

Perhaps the first concrete suggestion would be for the government to step back in the umpires' role and scat the horde of visionary, scholastic busybodies in the legal, planning and research and consumers divisions.

Figs. 1 and 2—Typical examples of cast bronze tablets in which every detail is reproduced with most minute accuracy

Use Plaster for Foundry Patterns

Pattern and molding practice differ to a considerable extent from the ordinary

WITH the exception of a small number of men actually engaged in the production of bronze tablets and other castings of a similar more or less ornamental character, comparatively few foundrymen or patternmakers have more than a hazy idea of the methods and materials involved. Of course this is not a matter of reproach. Tablets are not ordered on a quantity basis. The entire volume of business in this line for any given year is limited, entirely within the capacity of the comparatively small number of foundries which specialize in the production of ornamental bronze castings. The great majority of foundrymen and patternmakers never are brought into contact with this branch of the art, hence their unfamiliarity.

To some extent this is unfortunate. Every branch of the casting industry presents certain peculiarities in the manipulations of methods and materials. Specialists in every line have developed their technique to a high state of efficiency while remaining profoundly ignorant of the progress made by contemporaries in related or unrelated fields of endeavor. In many it not actually in all instances, it is safe to say that progress in any specialized line is accelerated when based on a broad general foundation. The man with extended general experience is in a better position to draw conclusions or to formulate a policy to meet any given set of conditions, than a man who consistently has followed one groove, or who through mental laziness or lack of opportunity has failed to keep in step with the industrial procession. All of which is by way of intimating that several features in the bronze tablet casting technique, readily may be adapted with advantage in the production of other lines of castings.

Expansion of this theme with particular reference to the use of plaster of paris will be presented in a later article. The present description is confined to the methods of producing bronze tablets at the plant of the W. S. Tyler Co., Cleveland. In the main the methods are typical of

those pursued elsewhere. References to minor modifications here and there are introduced merely by way of comment.

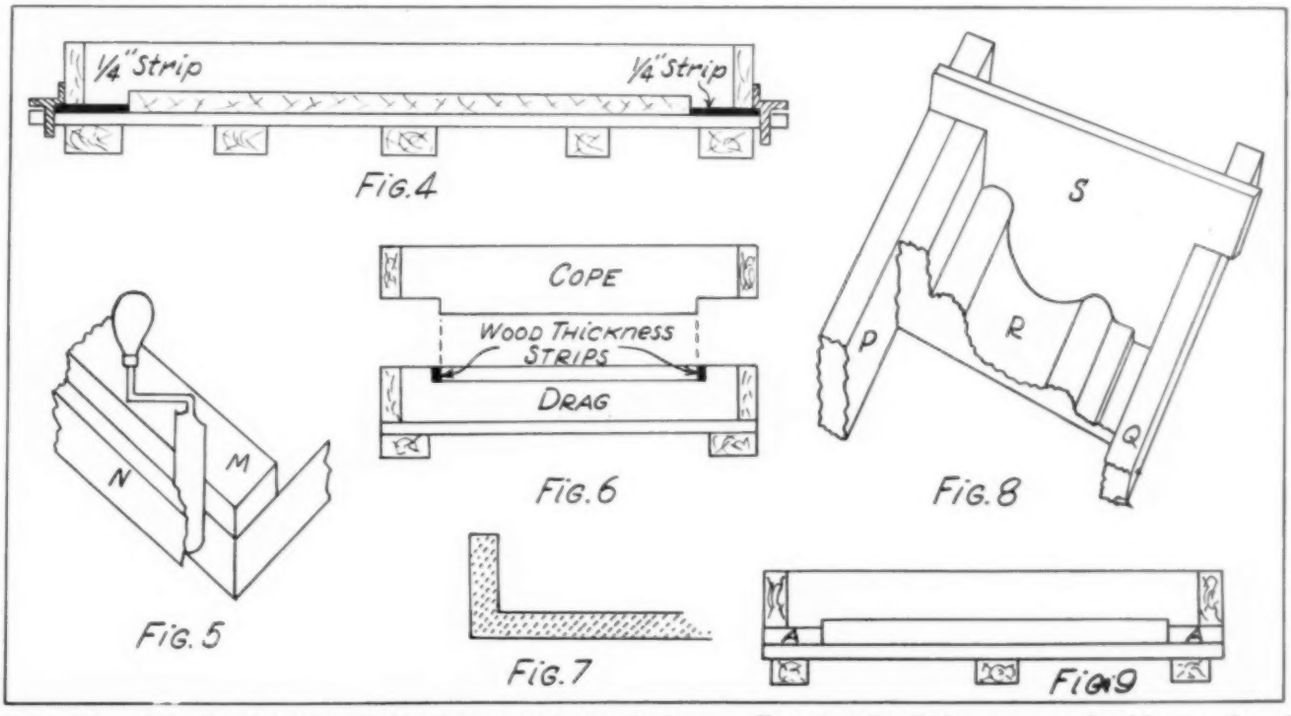
In the majority of instances the customer has no clear idea of what he wants. Since usually he is neither an artist nor a phrase maker he has to enlist the service of men skilled in these items. He has the choice of two alternatives. He can submit his problem to an artist and modeller capable of transforming an intangible idea into an object of three dimensions. Occasionally he is satisfied with the first attempt. Usually he suggests certain changes or modifications. The artist incorporates these changes in the original design and then prepares a pattern for the foundry, or merely prepares a model from which the foundry prepares pattern for actual use.

Meeting the Customer's Needs

In the second alternative method the customer lays his proposition before a company, in this particular instance the W. S. Tyler Co., Cleveland, prepared to carry the work through from the first intangible suggestion to the finished casting. The customer first is shown an extensive list of illustrations from which to make a possible selection. In the event that none appeals to him, the designer prepares and submits several sketches which in his opinion will meet the customer's requirements, conform to artistic standards and harmonize with the general surroundings of the location where the tablet is to be erected. In many instances, particularly where the customer is a committee from an organization, or a family party with widely divergent views on what is and what is not appropriate, the tact, sympathy and suavity of the designer may be severely taxed by the time the final O.K., is placed on the design. However, all this is recognized and accepted as part of the day's work and a tacit admission of the doctrine that the customer always is right since he pays the bills.

Fig. 3—This tablet was erected in memory of the children who lost their lives in the Collinwood school fire, Cleveland, March 4, 1908

Typical examples of tablets designed to meet varied requirements are shown in the accompanying illustrations. The dignified, patriotic note is struck in Figs. 1 and 2, individual honor rolls of the men from fraternal organizations and industrial plants who served during the world war in the (*Please turn to page* 52)



Figs. 4 6 and 9—Wood strips used for bottom and side thickness. Fig. 5—Side thickness secured with trowel and straightedge. Fig. 7—Typical casting section. Fig. 8—Molding sections are formed with strickles and guides

Interest in A. F. A. Convention And Exhibition Spreads Rapidly

FOUNDRYMEN throughout the country are exhibiting marked interest in the annual convention and exhibition of the American Foundrymen's association and the fifth International Foundry congress which will be held in the new convention hall in Philadelphia, Oct. 22 to 26. Realizing the potentialities of this particular convention and exhibition, the most elaborate in four years and the first international meeting in America in almost a decade, foundry owners, superintendents, foremen, salesmen, metallurgists, research men, and many others related in any way to the castings industry now are making definite plans to be in Philadelphia the fourth week in October to have a part in the technical sessions and to inspect the newest developments in foundry equipment and supplies.

Activities of the convention week will center in the beautiful new convention hall, where ample facilities are provided for the wide variety of exhibits which always add attractiveness to the foundry show, and for the technical meetings, round table luncheons, committee meetings and other well planned affairs of the convention week. Those in charge of arranging the multitude of details so necessary in the successful staging of this highly educational event have spared no effort to provide a program which will be of maximum benefit to all. A committee of the Philadelphia Foundrymen's association is co-operating with the A.F.A. to provide information for convention visitors on the beautiful city of Philadelphia, its many points of historic interest, parks, foundries, industrial concerns, and its numerous other unusual attractions.

For the first time since 1926, the United States will entertain a large delegation of leaders in the foundry industries of other nations. Following a tour of inspection which will take them to New York, Buffalo, Chicago, Milwaukee, Detroit, Cleveland, Pittsburgh and Washington, the overseas visitors will arrive in Philadelphia for the formal opening of the exposition. The technical sessions of the 1934 convention will present an exceptionally broad international background, for practically all of the important castings producing nations of the world are sending exchange papers covering a wide range of technical and practical problems. Perhaps as never before, convention visitors will have the opportunity of visualizing the world-wide progress which is being made in the art of castings manufacture.

The technical program recently released by the A.F.A. headquarters is undoubtedly one of the best in the history of the society. A well selected list of technical papers thoroughly covering many ramifications of foundry operations, a group of shop operation courses featuring sand control and cupola practice, round table luncheons where malleable, steel, cast iron and nonferrous problems will be discussed, and other activities, should prove of highest value in furthering world foundry progress. The tentative program is as follows:

Monday, Oct. 22

Registration and Committee Meetings.

12:00 Noon—Formal Opening of Exposition.

4:00 to 5:30 p. m.—Shop Operation Courses (Sand Control and Cupola Practice).

7:00 p. m.—Annual Alumni Dinner.

Tuesday, Oct. 23

10:00 a. m.—Formal Opening Meeting—International Foundry Congress.

2:30 p. m.—Nonferrous.

"Porosity in Leaded Bronze Bushings," by A. W. Lorenze, Bucyrus-Erie Co., Milwaukee.

"Effects of Elevated Temperatures on the

Strength and Dimensional Stability of Certain Aluminum Alloys Used in Aircraft," by R. R. Kennedy, Wright Field, Dayton.

"Cupola Melting of Red Brass," by W. C. Alvin, Imperial Brass Mfg. Co., Chicago.

2:30 p. m.—Steel.

"Steel Castings," by Dr. W. H. Hatfield, Brown-Firth Research Laboratories, Sheffield, England, (Exchange Paper, Institute of British Foundrymen).

"Controlled Directional Solidification," by George Batty, Steel Castings Development bureau, Philadelphia.

"Some Aspects of the Physical Chemistry of Steel Making," by P. Herasymenke and E. Valenta, Skoda Works Research institute, Pilsen, Czechoslovakia, (Exchange Paper, Czechoslovakian Foundry Association).

"Studies on Solidification and Contraction of Steel Castings," by C. W. Briggs and R. A. Gezelius, Naval Research laboratory, Washington.

2:30 p. m.—Apprentice Training.

4:00 to 5:30 p. m.—Shop Operation Course—Cupola Practice.

"Cupola Fore Hearths," by G. S. Evans, Mathieson Alkali Works, New York.

"Processed Petroleum Coke," by Clark B. Carpenter, Colorado School of Mines, Golden, Colo.

4:00 to 5:30 p. m.—Shop Operation Course—Sand Control.

9:00 p. m.—Reception to Overseas Convention Guests.

Wednesday, Oct. 24

10:00 a. m.—Steel.

Symposium on Porosity in Steel Castings, under the following leaders:

W. C. Woodward, Geo. H. Smith Steel Castings Co., Milwaukee.

C. E. Sims, American Steel Foundries, East Chicago, Ind.

George Batty, Steel Castings Development bureau, Philadelphia.

R. A. Bull, Chicago.

10:00 a. m.—Nonferrous.

Symposium on Deoxidation and Degasification of Nonferrous Casting Alloys.

"Introduction—Discussion of General Principles," by Dr. C. H. Lorig, Battelle Memorial institute, Columbus, O.

"Bronze Foundry Alloys," committee report, by O. W. Ellis, Ontario Research foundation, Chairman.

"Yellow Brass Casting Alloys," by L. Ward, Chase Brass & Copper Co., Waterbury, Conn.

"Aluminum and Its Alloys," by H. J. Rowe, Aluminum Co. of America, Cleveland.

10:00 a. m.—Cast Iron.

"Breaking Strength and Physical Properties of Gray Iron," by J. Novarro-Alacer (Spanish Exchange Paper).

"Permanent Mold Castings," by Fred J. Walls, Eaton-Erb Foundry Co., Detroit.

"Study of the Fluidity of Cast Iron," (Belgian Exchange Paper).

"High Chromium Cast Iron," by Garnet Phillips, Frank Foundries, Moline, Ill.

12:30 p. m.—Nonferrous Round Table Luncheon.

12:30 p. m.—Steel Castings Round Table Luncheon.

2:30 p. m.—Refractories.

4:00 to 5:30 p. m.—Shop Operation Courses (Sand Control and Cupola Practice).

7:00 p. m.—Annual Banquet—Medal Awards.

Thursday, Oct. 25

10:00 a. m.—Cast Iron.

"Cupola High Test Cast Iron," by R. P. Lemoine, Paris, France (French Foundry association Exchange Paper).

"Polishing Cast Iron for Microscopic Examination," by M. F. Surls, Michigan State College, East Lansing, Mich.

"Chemical Composition of Common Cast Iron for Boilers," by G. Sirovich and G. Vanzetti, Milan, Italy (Italian Exchange Paper).

"Heat Treatment of Cast Iron Cylinder Liners," by W. P. Eddy Jr., General Motors Truck Corp., Pontiac, Mich.

10:00 a. m.—Malleable Cast Iron.

"Metallography of Ferrite in Malleable Cast Iron," by Dr. H. A. Schwartz and C. H. Junge, National Malleable & Steel Castings Co., Cleveland.

"Effects of Copper in Malleable Cast Iron," by Dr. C. H. Lorig, Battelle Memorial institute, Columbus, O.

"Report of Committee on Nomenclature," by W. R. Bean, Whiting Corp., Harvey, Ill.

10:00 a. m.—Materials Handling.

"Selecting Foundry Equipment as an Investment," by R. J. Heisserman, Link-Belt Co., Philadelphia.

"Foundry Maintenance," by James Thomson, Continental Roll & Steel Foundry Co., East Chicago, Ind.

12:15 p. m.—Malleable Cast Iron Round Table Luncheon.

12:15 p. m.—Cast Iron Round Table Luncheon.

3:00 p. m.—Special Lecture—Annual Business Meeting.

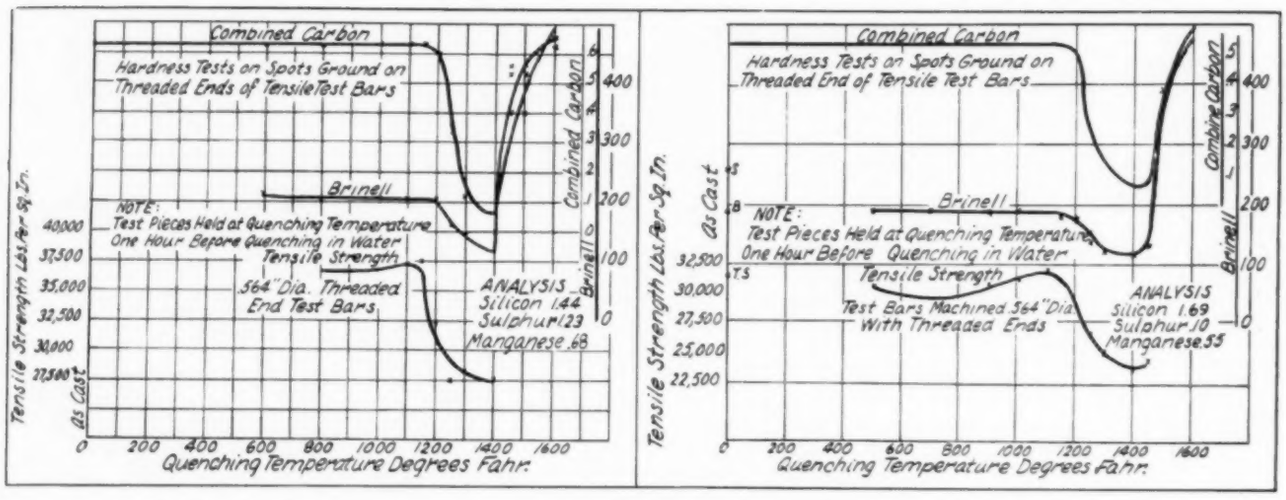
4:00 to 5:30 p. m.—Shop Operation Course (Sand Control and Cupola Practice).

10:00 p. m.—Exhibition open through the evening.

Friday, Oct. 26

10:00 a. m.—Sand Control and Research.

"Comparison of Some Methods Used In Determining the Fineness (*Please turn to page* 54)



Figs. 15 and 16—Results of systematic treatment of iron by Harper and MacPherran. All of the tests showed a drop in strength due to quenching

Heat Treatment of Cast Iron

Undertaken to relieve internal stresses or to change the structural constitution

By JOHN W. BOLTON

ALTHOUGH attempts to harden and strengthen cast iron by quenching and drawing without doubt were attempted many years ago, one of the first papers giving charts on the effects of systematic treatment of iron is that of Harper and MacPherran (*Transactions* A. F. A. 1922). These charts are shown in Figs. 15, 16 and 17. All of their tests showed a drop in strength due to quenching. The effect of draw after quench is not given. Some early work by the author (*Iron Age*, Oct. 2, 1924) is reproduced in Figs. 20 and 21. The metal, a 3.35 carbon, 1.65 silicon semisteel, as quenched in water was quite brittle so that only the as cast and the quenched and drawn properties were charted. Increases up to 40 per cent in strength were obtained by suitable treatments. Later investigations have been made by Potter, Coyle, Piwowarsky, Walls and Hartwell, Hurst etc.

Temperature Must Be High

In Fig. 18 Walls and Hartwell show the effects on hardness of different quenching media at different temperature quenches. As was the case in the author's experiments 1400 degrees Fahr. had to be exceeded before perceptible hardening was attained. The iron analyzed carbon 3.35 and silicon 2.30. Compare to this, results by the same investigators on an iron with nickel 1.12, chromium 0.83, shown in Fig. 19. The action of nickel in lowering the critical quenching temperature is quite apparent.

In Fig. 25 as prepared by Coyle the effects of draw back after quench are shown for some plain and alloy irons. Compositions of the irons shown in the chart are as follows:

No.	1	2	3	4	5	6
Total Carbon	3.10	3.12	3.10	3.15	2.68	2.69
Silicon	1.69	1.08	1.13	1.76	2.31	2.36
Nickel	0.00	0.00	1.21	1.13	1.22	1.22
Chromium	0.00	0.00	0.39	0.45	0.33	0.00

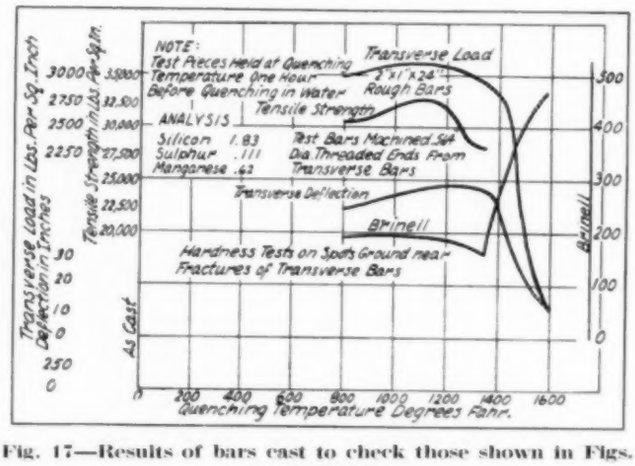
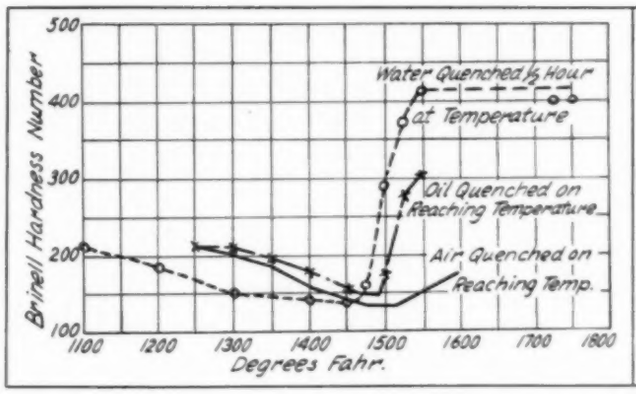


Fig. 17—Results of bars cast to check those shown in Figs. 15 and 16


Brinell Hardness Number
Water Quenched ½ Hour at Temperature
Oil Quenched on Reaching Temperature
Air Quenched on Reaching Temp.
Degrees Fahr.

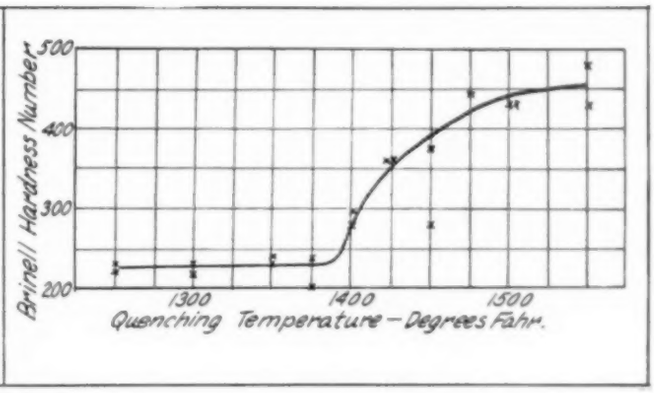
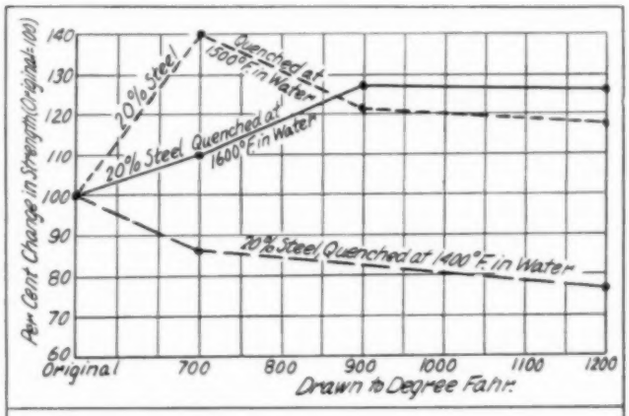


Fig. 18 (Left)—Effect of quenching temperature and medium on hardness of high silicon iron, by Walls and Hartwell. Fig. 19 (Right)—Effect of quenching in oil on brinell hardness of nickel-chromium cast iron

In Fig. 27, also by Coyle, loss in strength after quench and the effects of draw on a 3.10 carbon, 1.10 silicon cast iron are shown. Quenching temperatures which were employed in the investigation are as follows:

1. Quenched from 1400 Degrees Fahr.
2. Quenched from 1500 Degrees Fahr.
3. Quenched from 1700 Degrees Fahr.
4. Quenched from 1800 Degrees Fahr.
5. Quenched from 2000 Degrees Fahr.

A similar effect in alloy irons is shown by Hurst in Fig. 26. Analyses of the three irons


Per Cent Change in Strength (Original=100)
20% Steel Quenched at 1500°F. in Water
20% Steel Quenched at 1600°F. in Water
20% Steel Quenched at 1400°F. in Water
Drawn to Degree Fahr.

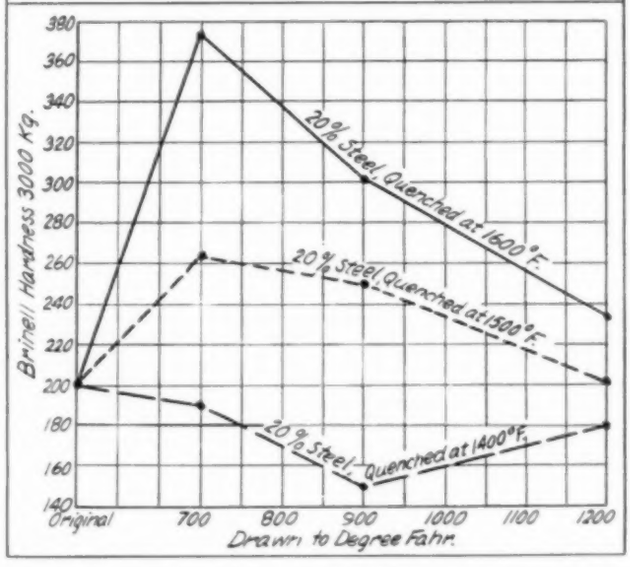
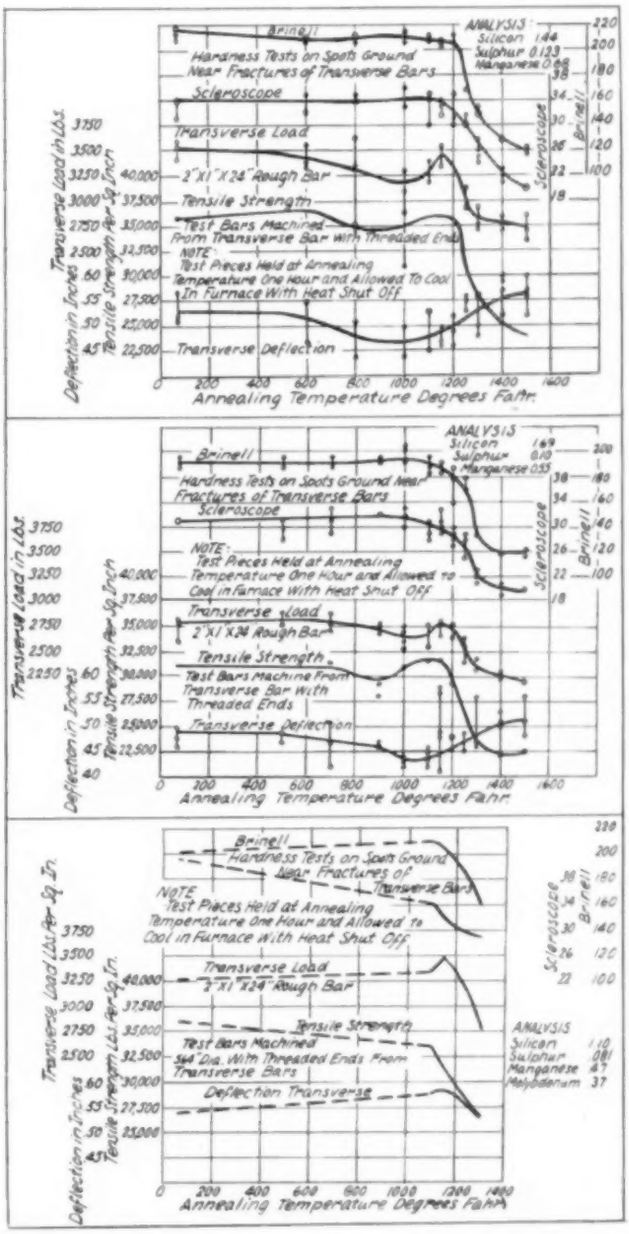

Brinell Hardness 3000 Kg.
20% Steel Quenched at 1600°F.
20% Steel Quenched at 1500°F.
20% Steel Quenched at 1400°F.
Drawn to Degree Fahr.

Fig. 20 (Above)—Drop in strength and other changes during heat treatment, by Bolton. Fig. 21 (Below)—Effect on brinell hardness of heat treatment at various temperatures


Brinell
Hardness Tests on Spots Ground Near Fractures of Transverse Bars
Scleroscope
Transverse Load
2"x1"x24" Rough Bar
Tensile Strength
Test Bars Machined From Transverse Bar With Threaded Ends
NOTE: Test Pieces Held at Annealing Temperature One Hour and Allowed To Cool In Furnace With Heat Shut Off
Transverse Deflection
ANALYSIS: Silicon 1.44 Sulphur 0.123 Manganese 0.68
Annealing Temperature Degrees Fahr.

Figs. 22, 23 and 24—Some of the results on the annealing of cast iron as determined by Harper and MacPherran

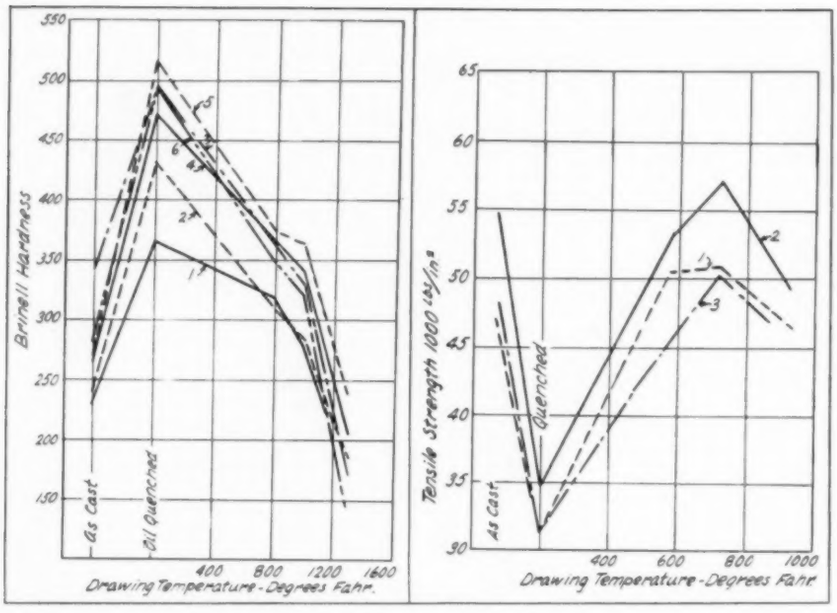


Fig. 25 (Left)—Effect of drawing temperature after quenching in oil from 1500 degrees Fahr. on brinell hardness of plain alloy cast iron. Fig. 26 (Right)—Effect of quench and drawback on brinell hardness of nickel-chromium cast iron piston rings, by Hurst

shown in that chart are as follows:

No.	1	2	3
Total Carbon	3.36	3.35	3.39
Silicon	2.30	2.07	2.09
Nickel	1.32	2.56	3.37
Chromium	0.44	0.95	0.61
Quenching Medium	Oil	Oil	Air

The general conclusions that can be drawn from these and other investigations on quenching cast irons are as follows:

(1) Oil or water quenching of gray irons (both plain and alloy) from above the critical temperature results in considerable increase in hardness. A common quenching range is 1500 to 1550 degrees Fahr. for plain irons. However, the strength is impaired and the metal is brittle. With suitable base compositions hardnesses up to about 600 brinell are attainable. The usual range is from 400 to 500 brinell.

(2) On drawing, little change, except possible removal of some embrittlement, is noted on draws up to 350 degrees Fahr. Above that point there is progressive slow softening and regaining of strength, the latter being maximum in the neighborhood of 600 to 700 degrees Fahr, as originally shown by the author. Hardness above the original is retained at draws up to about 1050 to 1110 degrees Fahr., depending on the iron. The maximum hardness is attained as quenched, and is retained up to about 350 degrees Fahr.

(3) Quenching and drawing is worthwhile only with suitable base irons, preferably with carbon under 3 per cent and close grained. Very good results ordinarily can be attained with *plain* irons. However, the use of alloys often is advantageous (a) to get good hardening in heavier sections, (b) lower critical quenching speed and (c) in some cases to lower the quenching temperature. Nickel, manganese, chromium molybdenum and the like have been employed, both singly and in various combinations. Special compositions with unusual hardness and toughness have been attained.

(4) As in all quenching treatments, highly complicated designs should be avoided. Heating up should not be so rapid as to produce severe internal stresses. Furnace atmospheres should be regulated to prevent heavy scaling. In other words the precautions necessary in successful heat treatment of steel also should be observed in treatment of cast iron.

(5) Properly quenched and drawn cast iron has a fine silky grain, which is lighter in color than regular gray iron. It has excellent wear resistance properties, both in metal to metal wear and under mildly abrasive conditions, retaining the freedom from seizure characteristic of regular gray irons. From 50,000 to over 80,000 pounds per square inch tensile can be produced according to the base iron and treatment chosen, with toughness above that of the original metal.

Since Piwowarsky's attainment of around 100,000 pounds per (*Please turn to page* 56)

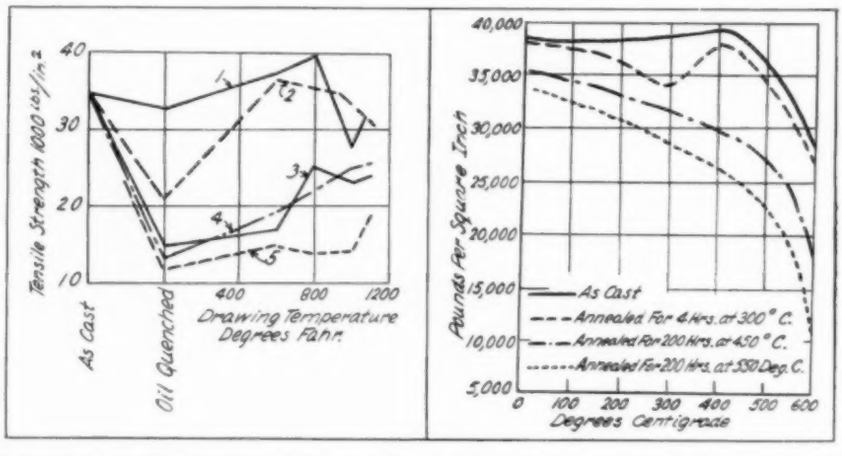

Tensile Strength 1000 lbs/in²
As Cast
Oil Quenched
Drawing Temperature Degrees Fahr.
Pounds Per Square Inch
As Cast
Annealed For 4 Hrs. at 300° C.
Annealed For 200 Hrs. at 450° C.
Annealed For 200 Hrs. at 550 Deg. C.
Degrees Centigrade

Fig. 27 (Left)—Effect of drawing temperature after quenching in oil on tensile strength of iron containing 3.10 per cent carbon and 1.10 per cent silicon. Fig. 28 (Right)—Tensile strength of cast iron at elevated temperatures, by Donaldson

Nonferrous Foundry Cost System

Association committee presents recommended procedure to the administration for approval

THE cost committee of the Nonferrous Foundry Industry code authority recently has formulated a proposed code accounting and estimating system in keeping with provisions of the codes of fair competition for the miscellaneous nonferrous sand castings and steel and rolling mill castings.

The purpose is to provide a satisfactory system for those wishing to install or to change over their present system and at the same time provide a standard for estimating purposes and a standard to be used in checking up claimed violations of the code. The committee points out that the minima under this system will not recover full actual costs until such a time as the volume of business returns to normal and unless the cost of doing business, Item I, is included.

Provision is made that average departmental costs for each plant over a period of the preceding 6 months or 1 year, as developed by the proposed system either in its simplest form or more detailed, shall be used by each plant for estimating costs so that quotations shall not be below costs. In case any plant fails to, does not desire to or cannot establish these average departmental costs for its own plant, then the company shall be governed by the average departmental costs so established in three to five plants in the district doing a similar class of work. Number and selection of plants and determination of the averages will be under the executive committee of the nearest local chapter, and all findings will be subject to the approval of the code authority.

Whenever a material change occurs in wage rates, material or supply prices of overhead expenses, new averages of departmental costs should be figured and from then on the new departmental costs used in estimating. All labor is to be estimated on the basis of paying wage rates at least equal to the average rates being paid in the territory for the class of work performed.

Where some of the departments shown in the system are not operated in the plant in question, they need not be considered.

The proposed system is as follows:

I. *Cost of Doing Business (Profit and Loss)*

The following are considered as profit and loss items and are not figured as a part of costs but come out of apparent profits before any real profit is realized on business done.

11. Interest on Investment
12. Interest on debt.
13. Dividends on stock or bonds.
14. Research and development expense.
15. Bad accounts.
16. Declines in market value of inventory.
17. Special sales or advertising campaigns.

II. *Fixed Overhead*

Amount of fixed overhead to be distributed and absorbed is based upon relation of total business to the normal amount of business.

21. Rent.
22. Building maintenance and watchman.
23. All taxes except income taxes and sales taxes.
24. Fire insurance and all other insurance (except workman's compensation group life and health, unemployment insurance).
25. Depreciation of buildings.

The basis for depreciation shall be original cost including freight and installation, except that in the case of plant and equipment acquired at an abnormal price the basis shall be the fair replacement value of such assets. Brick concrete or steel frame minimum 2 per cent; Masonry with frame interior minimum 3 per cent; Frame minimum 4 per cent; Corrugated iron minimum 5 per cent.

26. Depreciation of equipment. Same basis as for buildings but at average flat rate of not less than 10 per cent.
27. Administration and office expense, directors' fees, dues, subscriptions, legal expense, auditing expense, etc.
28. Sales expense, commissions, advertising.

The least portion of fixed overhead which must be absorbed is that percentage of the total fixed overhead that the current volume of business in pounds of good castings produced during the preceding three calendar months bears to the *normal* volume of business in pounds for the particular plant. The *normal* volume of business in pounds for any plant is considered as 60 per cent of that plant's best 6 consecutive months production since Jan. 1, 1924 (10 years). If, however, added capacity has been made by such plant since the period (*Please turn to page* 60)

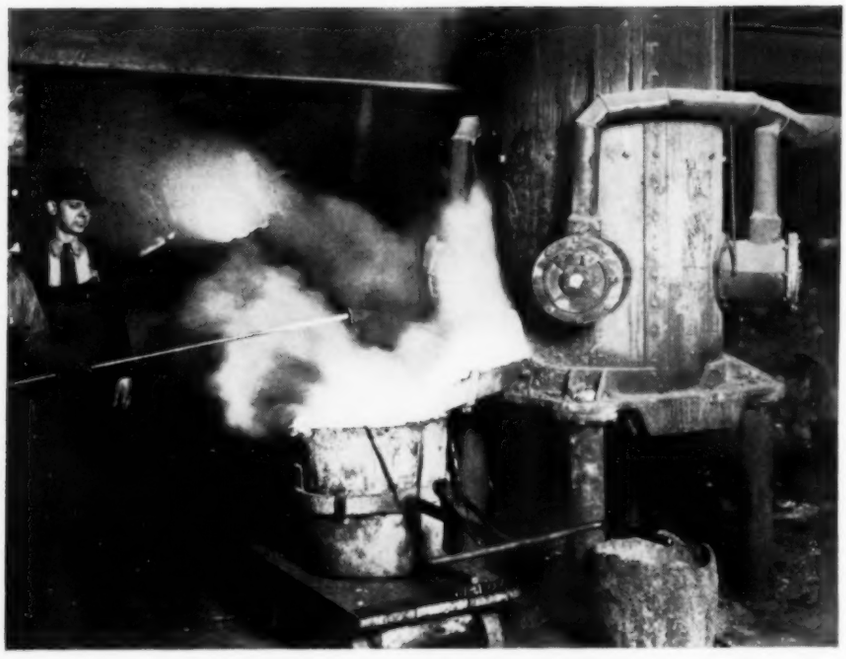


Fig. 1—To prevent the sticky slag from sinking to the bottom of the cupola, it is better to take the metal in two taps

Melts Bronze in a Small Cupola

With slight change in operating technique cupola becomes nonferrous melting medium

By JOHN DUFFY

CONTRARY to a somewhat general belief, based principally on a lack of actual first hand knowledge or experience, the cupola is as well adapted to melting bronze or red brass, as it is to melting iron. The prevailing attitude on the part of foundrymen is due partly to the fact that early experimenters employed gray iron melting technique, and partly to the fact that certain cokes, while fairly satisfactory for melting iron are not particularly well adapted to melting nonferrous metal.

Intermittently over a period of many years THE FOUNDRY has presented articles dealing with the experience of men who melted copper, red brass and bronze in the cupola. Within the past few years a special coke and a modified type of cupola has been developed for that purpose.

The special coke shows the following analysis: Fixed carbon 98.5 per cent, sulphur 0.4 per cent, ash 0.5 per cent. This coke is extremely hard, has high compressive strength, and does not crush under a heavy load. In addition it contains only a negligible amount of breeze or dust.

In melting gray iron in the cupola we anticipate a 10 per cent loss in the silicon content of the charge. No silicon is present in the bronze charge, but the danger always is present that some will be picked up. In the author's opinion this is the greatest hazard incident to melting bronze in the cupola. The usual sulphur pickup is eliminated by the use of a special coke and a small quantity of fused soda ash. Improper manipulation of the cupola may oxidize the metal, but the same holds true for any metal.

A concrete illustration of the methods, materials and equipment employed is presented in the following description of a typical installation of two cupolas, shell 36 inches in diameter, lined to 22 inches and capable of melting 2000 pounds per hour. One cupola melts an alloy containing copper 80 per cent, tin 10 per cent and lead 10 per cent. The second cupola melts a modified form of the ordinary red brass mixture containing copper 85 per cent, tin 5 per cent,

lead 5 per cent and zinc 5 per cent.

Each cupola shell is protected by a lining of insulating brick. The lining proper is made up of a special mixture high refractory blocks. An opening at the back of the cupola opposite the tap hole facilitates the making up of the sand bottom and removal of the slag after the bottom has been dropped. After the fire has been properly started this opening is closed for the remainder of the heat.

Each of the four tuyere openings is 3 inches in diameter in the lining, but each tuyere casting on the outside of the shell is 8 inches in diameter and 10 inches in length. The outer end contains four radial openings and these in turn may be fully closed or opened or maintained at any stage between, by a revolving shutter. In this manner the volume of draft may be adjusted to meet special conditions. Normally the blast pressure is 3 ounces and the volume 300 cubic feet per minute.

Particular care is observed in ramming the sand on the bottom door. Hard sand causes the metal to boil and eventually work its way through the bottom. The sand should be rammed to approximately the same density as sand in a green sand mold. Since the tap hole will be opened and closed 70 times during the day, a special block is preferable to the usual tap hole formed in clay or a mixture of sand and clay. A tap hole $\frac{5}{8}$-inch in diameter is large enough.

Fig. 2—The cupola becomes heated more uniformly where small masses of metal alternate with the coke charges

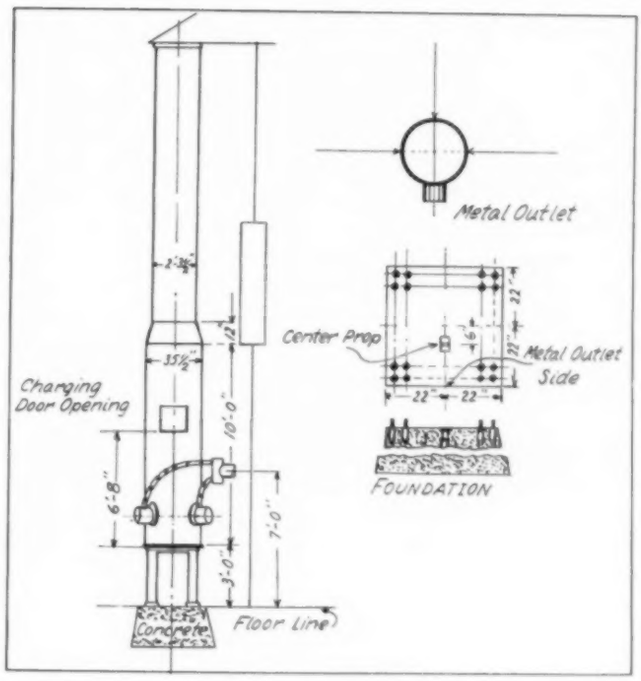


Fig. 3—Diagram showing construction of cupola used in the melting of brass and bronze, and illustrating position of metal outlet, slag outlet and charging door

The sand bottom slopes slightly from the back to the front so that all metal will flow in that direction.

The fire may be started with wood or with a torch inserted through the opening at the back. Any nails in the wood should be removed. Coke is added in small amounts until it is well burned through to a point about 27 inches above the tuyeres. The first metal then is charged on the incandescent bed, provided a sufficient number of molds are on the floor to take the metal.

Advises Splitting the Metal Charge

Even though for convenience the metal is made up in 500-pound charges, it is advisable to split the charge by placing 250 pounds of metal on the coke bed. This is followed by 15 pounds of coke and the same proportion is maintained up to the charging door. In this manner the cupola lining becomes heated more uniformly than where heavy masses of cold metal alternate with the coke charges.

After the cupola has been in operation for 2 hours, fused soda ash is added to the extent of 1.00 per cent of the metal charge, that is $2\frac{1}{2}$ pounds for each 250 pounds of metal. This material is available in brick form and readily may be broken into small pieces for distribution over the coke charge.

Half an hour after commencing to charge the soda ash, the slag hole is opened. Condition of the furnace is indicated by the appearance of the slag. A dark brown, fairly thick slag shows that the melting process is progressing favorably. A thin watery slag with white splashes is a warning that the furnace is working too hot. Under

normal conditions the cupola will melt four charges or 2000 pounds per hour. By increasing the blast this amount may be increased, but it will be at the expense of the metal quality. Better results are secured where a suitable steady pressure and volume of blast are maintained, than where these factors are varied by intermittent opening and closing of the gate in the blast pipe.

After running an hour or two on ingot charges, it is customary to introduce miscellaneous material, foreign and domestic scrap and borings. It is claimed that metal is refined to some extent in the cupola, but care must be exercised in selecting scrap if the resulting metal is to be poured into quality castings. Borings up to 50 per cent of the weight of the charge may be used, but the origin of this metal should be known. The most suitable amount to use at any given time will depend on the condition of the cupola.

Fracture Tests Should Be Made

With reasonable care good metal is produced by the cupola day after day. However, the human element must be taken into consideration. Occasionally something will go wrong. A reducing atmosphere maintained in the cupola all the time favors slag decomposition and pick up of silicon at high temperatures. Where the metal is poured into small castings it is advisable to break one occasionally throughout the day and note the character of the fracture. Where it is apparent that the cupola is not working properly a sample casting poured from each pot should be broken for examination. In this manner a close check is kept on melting conditions.

Presence of a large amount of carbon monoxide gas is incident to a reducing atmosphere. That is why the height of the coke bed must be varied under different forms of metal. If a charge of borings was melted on the high bed needed for ingots, it would be gassed. With other types of furnaces the best practice is to start with a reducing and finish with an oxidizing atmosphere. This cannot be done in the cupola. Neither is it possible to secure the ideal, or neutral atmosphere.

Apart from possible gas absorption, the principal hazard in cupola melting is silicon pickup, particularly in melting bronze with a high lead content. A broken casting will show an open grain and a bright yellow streak in the center. Presence of a fine gray powder also will be quite noticeable. This is silicate of lead and a proof of a silicon pickup, and may be traced to any one or all of three causes: Extra hot lining, forcing the furnace, or character of the charge. Where large pieces of scrap are charged the metal will not absorb heat fast enough and the melting zone becomes intensely hot, thus favoring the breaking up of silicon compounds.

A drum containing a full charge of borings should be kept on the charging platform at all times. When the fracture of a test casting shows a silicon pickup, evidence that the cupola is too hot, conditions may be remedied immediately by charging the borings on the hot coke bed. The fine material trickles down between the pieces of coke and by actual contact cools the melting zone to a point below the temperature required for slag decomposition. The borings finally melt below the carbon monoxide zone and the metal drops into the well without absorbing gas. Suitable adjustments in the lead and zinc content are made in the pot before the metal from this charge is poured.

Combustion and consequent change in temperature result from the union of carbon and oxygen. A little consideration of the various reactions taking place in the melting zone of a cupola shows that the transfer of heat to the metal is intimate and direct. The hot gases are in intimate contact with the fuel and metal. Melting results from the conductivity of the metal. Heat applied at the surface is passed inward until the melting point is passed and the melted portion drops off. If this occurs close to the carbon dioxide section of the melting zone, the molten metal will be satisfactory. Two most important features in cupola operation are blast control and height of the bed.

Considerable Slag Is Produced

Assuming that the furnace is hot and the bed has settled a little, a good charge is made up of borings 35 per cent, scrap 30 per cent and ingot 35 per cent. These amounts may be varied to a considerable extent depending on the condition of the cupola. To the charge that this requires too much supervision, it might be pointed out that melting metal involves something more than throwing metal into a furnace and tapping it out. A little co-operation between the melter and the man who makes up the charges is all that is required.

A considerable amount of slag is produced when melting large amounts of miscellaneous scrap. In some cases it is necessary to keep the slag hole open continuously. Charges are made up from stock kept in various bins. Each charge is placed in a metal drum and hoisted to the platform. In Fig. 2 the operator has checked off on the cupola shell the number of charges placed in the cupola. This is a simple method, but a better way is for the man who makes up the charges to place two cards in each drum. The number of the charge and the composition is stamped on the cards, also the amount of borings, scrap and ingots. As the platform man places the charge in the cupola he slides the card down on a wire to a point near the spout. As each pourer takes his metal he hands the card to the checker who marks on the back the number of molds poured and the number of the job. These cards are collected by the time keeper who thus has a record of the metal (*Please turn to page* 64)

Casts Steel with External Chills

Casting section and the relationship of adjacent metal governs chill thickness

By RALPH BURKE

GROWING demand in recent years for better and more uniform physical properties in steel castings has prompted a study of means toward producing, within all parts of a casting, the same physical properties as obtained from a separately cast test bar from the same heat.

Exacting requirements due to higher speeds, heavier loads and increased pressures, and the necessity of limiting the weights for economy and practicability, have placed new responsibilities on the designing engineer and on the steel foundryman. The rapidly growing practices of making impact tests, x-rays, and proof tests with strain-gages or to destruction indicate a desire on the part of engineers and foundrymen to produce sound castings.

Physical properties, particularly those indicating ductility and impact value, are seldom as good when taken from a casting as when taken from a separately cast test bar from the same heat. One of many reasons is that usually it is more difficult to feed the section from which the test piece is taken than it is to feed a separately cast bar.

Chill Increases Cooling Rate

The principal function of a chill for steel castings is to promote a uniform rate of cooling in all sections, by increasing the rate of cooling in heavy sections so that they come to a solid state simultaneously with the lighter adjacent sections. External chills may be used to regulate the rate of cooling of the metal. The thickness of chill and the area covered may vary within reasonable limits and accomplish the desired result. Naturally, the thickness of chill is based on the thickness of casting section, and its relation to the thickness of adjacent sections. Chills placed near the gate must be heavier than those farther away. The chilling effect of very light chill sections is remarkable, but chills must not be so light as to curl up under the heat of the metal.

Checking or cracking of the casting surface next the chill face is one of the difficulties sometimes encountered in using external chills. This can be caused by using a heavy chill, a rough chill, or in any way allowing the casting surface to adhere to the chill face, preventing contraction on cooling. Chills must be very smooth, and protected by a covering to prevent adherence of the steel. A satisfactory method is to paint the chill with shellac, and dip it while still wet in fine, dry sand. This can be repeated if a heavier coating is needed. The sand coating not only prevents the molten metal from adhering, but tempers the severe initial chilling action, and assists in preventing surface checks. A small tumbling barrel will serve to keep the chills clean and smooth.

In some instances contraction causes the casting to crack at the periphery of the external chill. This tendency is reduced by chamfering the edges of the chill, as shown in Fig. 1.

For any except a flat (*Please turn to page* 64)

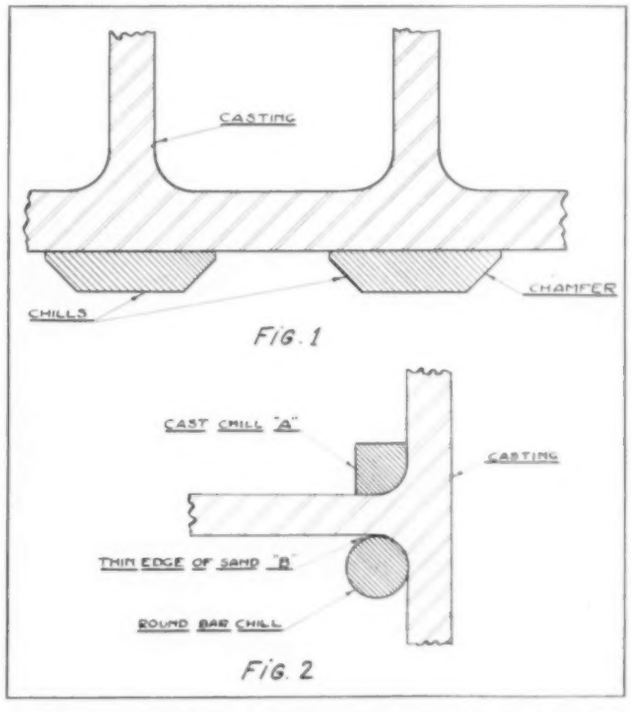


Fig. 1—Cracking at periphery of chill may be reduced by chamfering. Fig. 2—External chills may be cast to fit the pattern accurately

Fig. 1—Workmen laying cast iron blocks in a British street

Pave Roads with Cast Iron Blocks

Castings are finding favor for surfacing pavements in England, Germany and France

By E. W. DAVIS
University of Minnesota

IN EUROPE—England particularly, and Germany and France to a lesser degree—cast iron pavements are being used on an increasing scale and with satisfactory results. The largest and most recent installation is in the Mersey tunnel, at Liverpool, where about 3 miles of pavement have been surfaced with square cast iron blocks, specially designed for rigorous service.

Two distinct systems of cast iron paving are being tried out extensively in England. In one system, cast iron sections are used as surfacing for concrete, somewhat as brick or wood blocks are used in this country. In the other system, cast iron grids, supported directly on a crushed rock or gravel sub-base, replace the usual concrete base, and asphalt mastic is placed directly, making a smooth surface on an iron foundation.

The two types of surfacing blocks generally used in England are those made by Stanton Iron Works Co. Ltd., Nottingham, and by Iron Roads Ltd., London. Blocks made by the former are 12 inches square and those by the latter are in

Fig. 2—Street in Accrington, England, paved with cast iron blocks supplied by Iron Roads Ltd. The center lane was paved at a later date after trolley tracks had been removed

the form of equilateral triangles 10 inches on a side and are used in what is called tripedal unit system. In both cases, the blocks are about 2 inches thick and hollowed out on the under side to reduce the weight to about 25 pounds per square foot of paved surface.

Upper surfaces of the blocks are studded in a diamond-shaped pattern not unlike the treads of some makes of automobile tires. They ordinarily are laid on a 6 or 8-inch layer of concrete covered with a thin layer of asphalt mastic. About ¼ inch is left between the individual blocks and this space is also filled with mastic. The claim made for the triangular blocks is that they are supported at only three points and cannot rock. The square blocks are supported at five points.

Advantages stated for the cast iron block type of surfacing are as follows:

(1) Skid-proof in all kinds of weather.

(2) Claimed to outlast granite blocks, brick, or wood blocks.

(3) Distribute the load over a considerable surface of the cement base and, for this reason, the base is not subjected to sharp impact.

(4) Easily taken up and relaid when it is necessary to excavate for sewer, water, gas, or electric service lines.

(5) Do not shrink, swell, chip, or develop frost cracks.

(6) Automobile tires are actually "geared to the road," making the action of the brakes effective and yet causing no increase in tire wear.

(7) Clean, sanitary and glare-proof.

(8) No more noisy than any other type of pavement for automobile or truck traffic.

(9) Not affected by grease or oil.

(10) Quickly laid by unskilled labor.

Cast Iron Surfaced Roads in England

Location	Dimensions, feet Length	Width	Foundations	Shape of blocks	Time in use, years
Accrington	310	40		Triangular	2
Burnley	600	24	Concrete	Square	2
Deptford	Bridge decking			Square	
Folkestone			Concrete, 6"	Square	2
Hampstead	Cab stands				
Ilford	Trial section		Concrete, 8"	Square	
Leyton	Trial sections		Concrete, 9"	Square	3
Liverpool	15500	36		Square	
London	Around factory		Concrete, 6"	Square	
Luton	Around factory		Concrete, 6"	Square	
Rochdale	Trial section		Concrete, 8"	Square	2
Sheffield	150	10	Concrete, 6"	Square	2
Stockport	Trial section		Concrete, 6"	Square	
Stratford	150			Triangular	3
Worcester			Concrete, 8"	Triangular	
Birmingham	Trial section		Old concrete		1
London	Trial section		Concrete, 12"	Square	2

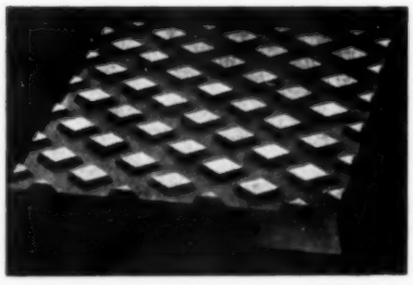


Fig. 3—Street in Burnley, England, paved with cast iron. Illustrations above show both sides of block used. Castings were made by Stanton Iron Works

Development of this type of pavement in England dates from about 1928. The first installations were made where maintenance on other types of pavement was excessive. They were put down at bus stops, taxicab stands, on bridge approaches, and between street-car tracks. The results were so satisfactory that iron blocks are now being used for the resurfacing of worn out cement pavements in London and many of the surrounding boroughs.

The accompanying table shows some of the installations of cast iron surfacing blocks in England regarding which some definite information has been received.

Comments from engineers in charge of installation and maintenance of these cast iron pavements indicate that the service obtained from them is satisfactory. One engineer reports there has been no cost of maintenance on the heavily traveled Rochdale section and says, "—it would appear that the cost of maintaining such a road (*Please turn to page* 46)

Reactions in Cupola Refractories

Different zones and the destructive forces in furnace complicate materials selection

By R. E. APTEKAR

Consultant, Ypsilanti, Mich.

EXPERIMENTAL and technical data on which to formulate incontrovertible conclusions on the selection and proper use of cupola refractories appear insufficient. This article is an effort at directing the best available data toward a practical and technical interpretation of the properties and behavior of such refractories.

C. E. Bales, (Transactions, American Foundrymen's Association, Vol. 36, 1928, pages 683 to 696), defines four zones in the cupola as follows: (1) Crucible; (2) Melting zone; (3) Zone at and below the charging door; (4) Zone above charging door. He differentiates between the fundamental physical conditions met in each zone. Similarly, he defines destructive forces in three groups:

1. Thermal
   a. Intense heat
   b. Thermal shock
2. Chemical erosion
   a. Slag and fluxes
3. Mechanical
   a. Abrasion by charges
   b. Abrasion by wind
   c. Destruction by chipping out.

J. M. McKinley, (Transactions, American Foundrymen's Association, April 1924, pages 494 to 496), points out that these factors tend to overlap in operation. Various researches indicating the vital chemical influence of oxidizing and reducing stack gases point to the inclusion of CO and $(CN)_2$ and CO_2 under 2b in the classification as gaseous chemical erosion.

J. T. MacKenzie, (Transactions, American Foundrymen's Association, April 1934, page 496), points to the influence of slag penetration as protecting refractories from mechanical abrasion and F. H. Norton in *Refractories* adds the factors of slag fluidity and wetting of refractories by slag as determining largely resistance to slag penetration.

Bearing in mind the essentially different requirements of refractories for the different cupola zones, and the divergent properties they possess to meet these conditions, we can approach the study of the chemical and physical characteristics of the practical refractories available to the foundryman.

From the chemical standpoint it is easiest to consider all refractories as being either acid, basic, or compounds of acids and bases of varying degrees of neutrality. Magnesite, dolomite, and limestone may be regarded as basic materials. Alumina has the property of forming either the basic portion of compounds with highly acid materials or the acid portion of compounds with pronounced bases such as magnesia or lime. Silica is the only practical acid refractory material.

Materials of these types are capable of form-

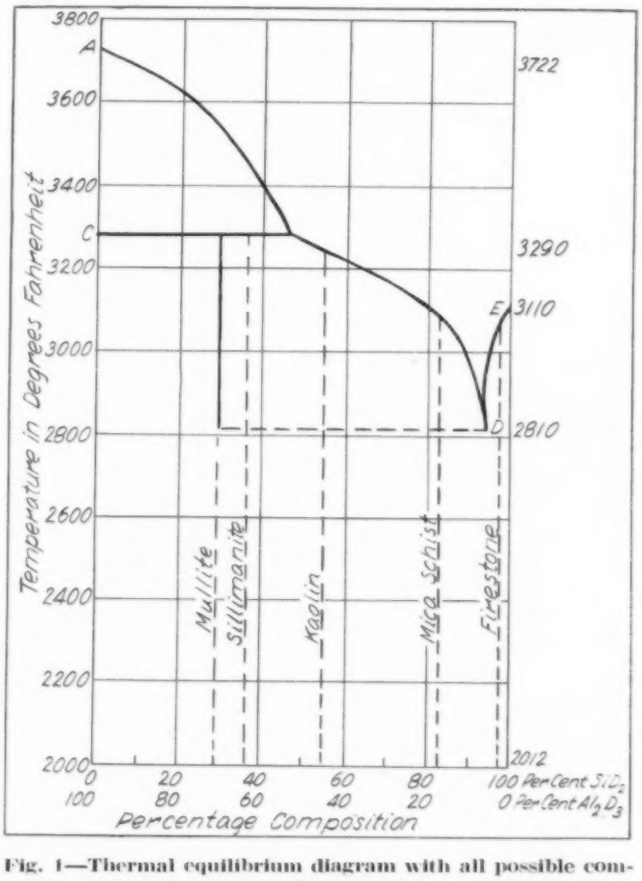


Fig. 1—Thermal equilibrium diagram with all possible compositions plotted in the horizontal plane, and temperatures vertically

ing an almost unlimited series of compounds of only slightly differing chemical composition, presumably in proportions of molecules. All slags are such compounds; nearly all refractories are mixtures of compounds. The raw materials of refractories, occurring in nature nearly all contain quantities of combined water which give entirely different properties to these materials as we know them before and after the water has been removed by burning.

In spite of their exceedingly high refractivity, basic refractories are not used in the cupola. They are capable of high resistance to slag and metal erosion, but it is believed no methods have been devised for making these up into blocks having the necessary mechanical resistance to shock and abrasion.

Until relatively recent times acid linings have not been much used in cupolas. Even today only the melting zone is lined with siliceous materials; more commonly only patching is done with acid stone. Typical analyses of such acid materials are given in Table I. These analyses are not specifications, merely typical of materials available.

Clays, both in their raw state and made up in burnt block and shapes are the most commonly used refractory materials. Raw clays differ widely in composition and even much more widely in properties and suitability. They are neutral compounds of silica and alumina with varying proportions of combined water.

The simplest and commonest clays approach kaolin in composition. This has the theoretical formula of one part of alumina combined chemically with two molecular parts of silica and two molecular parts of water. All kaolin type clays have more or less free sandy material present as impurities, and varying percentages of feldspar, a low fusion point rock from which clays are formed in nature by decomposition. A chemical analysis of a clay is therefore no true indication of its plastic or refractory properties.

Foreign Materials Govern Properties

The presence of these foreign materials reduces its plasticity; free silica grains reduce the shrinkage, feldspar depresses the fusion point. In addition, the degree of compression in the deposits of the clay determines largely the amounts of combined water residual in the clay and its hardness and working properties. Depending on its place and manner of deposition, clays contain varying amounts of carbonaceous matter, the burning out of which largely determines the porosity and resistance to slag attack on burning. An equally important variant not discoverable by chemical analysis is the particle size of the individual grains of the clay.

Clays unlike kaolin in composition are also found commonly. These may contain higher molecular proportions of alumina as the Missouri clays, higher proportions of silica as the West Virginia clays, or more molecules of water. Typical analyses are presented in Table II.

Profound changes occur in the composition of such clays on burning as typified by the block analysis in Table III, as typified in various components.

When made up into blocks, the physical make-up and method of manufacture of these blocks are at least of equal importance in determining the serviceability, as illustrated by R. C. Zehm and C. E. Bales. Because of the high shrinkage of all clays on burning and dehydration, and the attendant tendency to set up high internal structural strains, it is common practice among manufacturers to burn and crush to various screen sizes part of the clay intended for use in the block. This material, known as grog, is incorporated with the plastic clays into the mud from which the blocks are to be made. Depending on the method of manufacture prior to burning, differing degrees of density are obtained not only by governing the size of this grog but also by regulating the de-

Table I

Typical Analysis of Acid Materials

Name	Ganister	Silica Brick	Firestone	Firestone	Mica Schist
Locality	Wisconsin	Illinois	Penna.	Ohio	Penna.
Ignition Loss	0.03	0.36	1.76	0.41	0.99
Silica	98.22	94.70	89.75	93.35	83.50
Alumina	1.08	3.10	7.25	3.67	15.50
Iron Oxide	0.27	0.34	0.17	1.45	.....
Total Bases	0.78	2.32	0.61	0.30	.....
Fusion Point	3092	3060	3045 app.	.....	.....

Table II

Composition of Several Different Clays

Name	Kaolin	Ohio Clay	Indiana	Missouri	Wyoming	W. Va.
Type	Theoretical	Flint	Flint	Plastic	Bentonite	Plastic
Ignition Loss	13.94	11.36	11.24	15.60	14.72	9.84
Silica	46.51	56.75	50.43	29.14	58.32	61.44
Alumina	39.96	25.47	34.67	49.98	20.69	26.18
Iron Oxide	.....	1.96	2.27	1.42	3.66	0.66
Total Bases	.....	4.46	3.66	2.88	6.22	0.80
Softening Point	2810	2690	2792	2800	.....	.....
Fusion Point	3254	3168	3085	3398	2444	3219

Table III

Composition of Clays After Burning

Name	A	B	C	D	E
Type	Mullite	Silica	Cupola	Missouri	Clay
Ignition Loss	1.03	0.36	0.05	0.64	0.44
Silica	74.80	94.70	60.20	52.94	63.42
Alumina	24.09	3.10	37.10	40.26	28.28
Iron Oxide	0.14	1.98	0.20	1.96	0.24
Total Bases	.....	.....	.....	4.75	.....
Fusion Point	.....	.....	.....	3128	3002

gree of wetness of the mud and the extent of compression in block formation.

Entirely different physical characteristics thus are imparted even before burning. Coarse, high grog content blocks are destined to be porous, low heat conducting, low abrasion resisting, low in susceptibility to spalling and easily attacked by slags. Bricks of similar physical ingredients more highly compressed have these properties modified in proportion to the pressures used. High clay content blocks containing fine grog or low percentages of grog are dense, likely to deform in burning, have high heat conductivity, are strong and hard, spall readily and are very resistant to slag erosion.

As different clays exhibit widely differing shrinkage rates and structure after burning, the tendency has been to mix different clays to obtain compromise properties in these respects. That the results obtained have not been entirely satisfactory is due to the complexity of the reactions, both physical and chemical, which occur in burning and subsequent use.

Temperature of burning and time of burning largely influence the properties obtained. In general the higher the burning temperature the more stable the block and the greater its resistance to subsequent softening. Similarly, the longer the burning time, the better the behavior of the refractory in the cupola. There are available today fused and cast refractories which give fine results, but their cost is high, and manufacture difficult.

Thermal Diagram Gives Key

These complex variations in properties can be understood more easily by considering briefly the thermal equilibrium diagram of Bowen & Greig. Unfortunately the diagram, shown in Fig. 1, is not complete in its details.

Disregarding for the moment that there are varying quantities of impurities in all refractories, which tend to lower the fusion point and affect other properties, all practical cupola refractories may be considered as compounds of alumina and silica. In a horizontal plane, we can then plot all possible compositions of such refractories.

The left side of the diagram represents a composition 100 per cent pure corundum, Al_2O_3; the right side a composition of 100 per cent SiO_2. Temperatures are plotted vertically. The fusion point of Al_2O_3 is 3722 degrees Fahr.; that of SiO_2 is 3110 degrees Fahr. Of all the possible compositions the lowest fusion point or eutectic compound has about 94 per cent SiO_2 (Seger). Its fusion point is 2810 degrees Fahr. The curved line *ABDE* represents these fusion points. Above the curved line connecting these points all compositions are in a fused state. Below, they are either entirely solid or are in a plastic condition of varying stiffness in which they offer considerable resistance to change of shape under pressure.

The dotted line *FD* at 2810 degrees Fahr. extends horizontally along the temperature line from the composition 28 per cent silica to 94 per cent silica to its juncture with the eutectic point *D*. The area *GBDF* represents those temperatures at which refractories having compositions with limits of these silica contents are in a semiplastic condition. At any point within this area the vertical height represents the difference in degrees between the softening point and the fusion point of these refractories.

The line *CGB* extending along the point of fusion of mullite to its intersection with the fusion point curved line forms the upper boundary of the area *CGOH* in which all the included compositions are solid. The triangle *ABC* is an area of fused transition stage material. The area *HFDEJ* represents the solid phases of refractories having under 72 per cent alumina.

Silica Controls Plasticity

Two striking facts are brought out by this diagram. Compositions of 0 to 28 per cent silica present no area of semiplasticity. They are rigid up to the point of fusion. Similarly compositions of 94 per cent silica and higher exhibit these properties, but their fusion points are lower.

Comparing the distinctive characteristics of the principal compositions in this diagram is instructive. If fused corundum should be cast into blocks, the resulting refractory would have an exceedingly high fusion point. Its crystal structure would be coarse; the refractory would be brittle, easily attacked and penetrated by either basic or acid slags; and it would not resist heavy loads.

At the other extreme of the diagram, pure silica, if fused, would show a fusion point of only 3110 degrees Fahr., would have a dense structure, low thermal expansion, easy surface reactivity to basic slags, but low slag penetration.

The mullite composi- (*Please turn to page* 67)

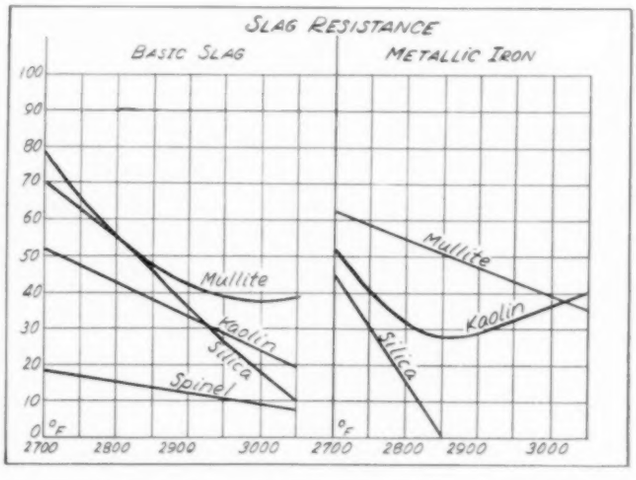


Fig. 2—Effect of temperature on slag resistance of several types of refractory materials

Makes Large Generator Casting

Base casting for turbine generator plant poured from iron melted in four furnaces

THE Westinghouse Electric & Manufacturing Co., with headquarters and works at East Pittsburgh and with plants located at various industrial centers has produced many large castings in the foundry operated at Trafford, Pa., about 12 miles east of Pittsburgh. The largest and heaviest casting ever produced in this shop recently was completed for the Philadelphia Electric Co., for installation at the Richmond station on the Delaware river. The casting shown in the accompanying illustrations is a cylinder base for a turbine generator set rated at 183,333 kilovolt amperes, 90 per cent power factor, 1800 revolutions per minute, 3-phase, 60 cycle, 13,000 volts.

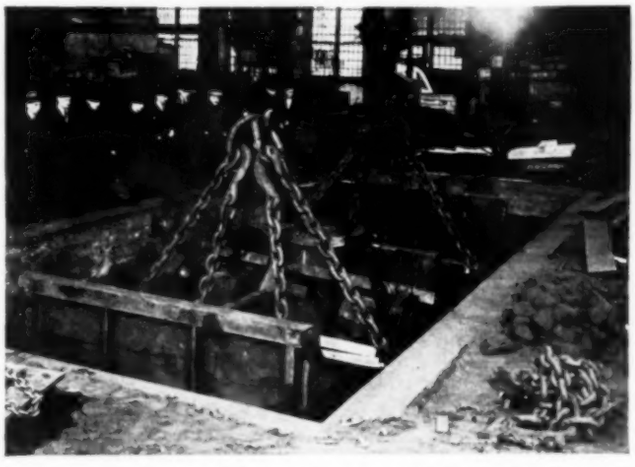


Fig. 1—To prevent the mold from straining, the sand all around a full size pattern was rammed in a concrete pit

Weight of the cleaned casting is 175,000 pounds. Additional weight of gates, risers and melting loss necessitated the melting of 210,000 pounds of iron in two air furnaces and in two cupolas. Outside dimensions include width 10 feet 3 inches, height 11 feet 3 inches and length 28 feet 6 inches. In this connection it is interesting to note that the casting did not vary at any place more than ¼-inch from the anticipated dimensions. One tenth instead of the more usual ⅛-inch per foot contraction was allowed on the pattern.

To prevent the mold from straining, the sand around a full size pattern was rammed in a concrete pit 12 x 18 x 36 feet. Thus the wall of sand at each end of the casting was 3 feet 9 inches thick, while the wall of sand at each side was approximately 4 feet thick which is not much more than would have been necessary had a flask been employed. The pattern was little more than a plain rectangular box strongly braced on the inside to resist the pressure of the rammed sand on the sides and ends. In effect it was a glorified core print and left a large rectangular cavity in the sand. A number of large dry sand cores built up against the side and end walls formed the necessary ribs, openings, etc. Additional cores built up on the inside and supported where necessary on chaplets formed the remainder of the mold interior and the cope.

Tickness of metal in the casting varied from 1⅝-inches to 12 inches imposing severe shrinkage and contraction strains. To obviate the hazard incident to this wide variation of thickness to some extent, reinforcing ribs were added as shown on the side face Fig. 2. Chills were incorporated in the mold at a few points to hasten the cooling of the metal in the vicinity. Binders and bolts were released so far as possible after the casting had solidified (*Please turn to page* 44)

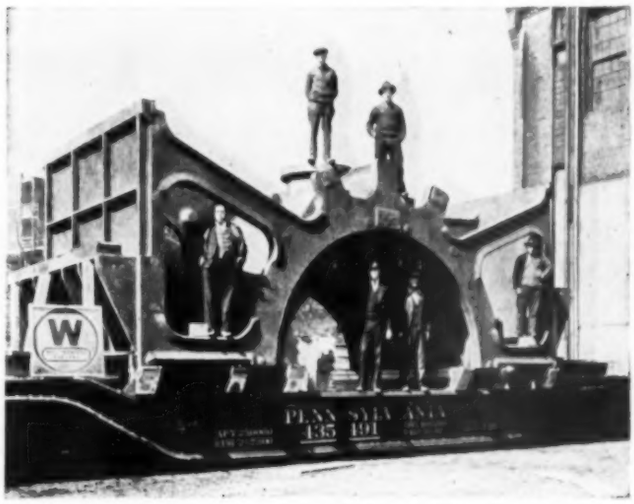


Fig. 2—The finished casting weighed 175,000 pounds, while additional weight of gates, risers brought the total poured to 210,000 pounds

Questions and Answers

Covering important problems found in all phases of modern foundry practice

This department includes problems relating to metallurgical, melting and molding practice encountered in making castings. Questions from subscribers addressed to the Editor of The Foundry will be answered by members of the editorial staff, supplemented where occasion requires by the advisory staff.

Gives Bushing Mixture For Use in Trolley Wheels

What composition is suitable for small bronze bushings for use in trolley wheels? The bushings range in size from ½ to 1-inch inside diameter with a 3/16-inch wall and in lengths of 1½ and 2 inches. The bore is rifled either with a core or by machine, and the rifling filled with graphite paste. We want an alloy which will not be too difficult to machine on a production basis, but still will give good service in use.

We believe that you will find that an alloy that varies slightly from the well known 80-10-10 will fill your needs as it is not difficult to handle in the foundry and machines well. The desired composition of the alloy to be used is 79.25 per cent copper; 10 per cent tin; 10 per cent lead, and 0.75 per cent zinc. The alloy is deoxidized with phosphorus, and the maximum amount of that element retained is limited to 0.01 per cent.

Finds Dry Sand Molds Leave Marks on Surface of Castings

Our dry sand castings occasionally show line indentations, which are due to mold cracks. Molders generally fill the cracks with blacking and this material appears to squeeze out when the iron is poured into the mold and produces indentations which customers sometimes mistake for cracks in the castings.

Expansion of the sand when the iron is poured into the mold causes the cracks to close with the result that some of the blacking is forced into the face of the casting. The mold cracks during the drying process because the sand carries an excessive amount of clay. The obvious remedy is to change your facing mixture either by cutting down on the amount of new sand, or, by adding a quantity of sharp sand to the mixture.

Where dry sand molding is practiced extensively the foundryman has a wide choice of natural sands which may be used in any proportion up to 100 per cent. These sands will not crack during the drying process. Where dry sand molds are made only intermittently, the foundryman can *doctor* a batch of his available sand by the addition of sharp sand and practically any other binder in preference to large quantities of clay wash. Incidentally there is no need of closing small cracks.

Several Alloys Available For Making Roll-Neck Bearings

We have an inquiry to supply roll-neck bearings for a local mill, and we will appreciate any information you can give us on a suitable alloy for that purpose.

Roll-neck bearings, like many other castings, are made from various mixtures to satisfy specifications laid down by the purchaser, or to meet particular ideas of the foundryman. In general the old reliable 80 per cent copper, 10 per cent tin, and 10 per cent lead will serve satisfactorily. Sometimes the 88 per cent copper, 8 per cent tin, and 4 per cent lead alloy is used, and it also is said to give good results.

Pinholes in Aluminum Casting Caused by Absorbed Gases

We are making cast aluminum signs for stores, etc., containing raised letters and borders which are polished. After polishing we notice that the surfaces contain tiny pinholes. A fine grade of sand recommended for the work is used, and care is taken to see that the molds are blown out. We also observe that after the signs have been exposed to the weather that they develop a whitish appearance on the polished surface. The metal used is composed of 50 per cent virgin aluminum, and 50 per cent crankcase scrap.

We believe your trouble is caused from gases absorbed by the aluminum alloy during melting, which are ejected as the metal begins to solidify. The remedy consists in not heating the metal to a higher temperature than is absolutely necessary, melting it as fast as possible,

and not permitting it to remain under heat for any length of time after the metal has reached the pouring temperature. Ordinarily aluminum alloys should not be heated to more than 1300 to 1400 degrees Fahr. Also in pouring, see that the lip of the ladle is as close to the sprue opening as possible.

The whitish appearance observed is due to the formation of aluminum oxide produced under action of the atmosphere. Usually the oxide coating on aluminum and its alloys is gray rather than white, but perhaps appears whitish when contrasted to the polished surface. Application of a coat of synthetic resin varnish or lacquer or perhaps beeswax and paraffine dissolved in solvent naptha or carbon tetrachloride will delay weathering to some noticeable degree. However, for the type of work you are doing, we believe that you will obtain better results by using an alloy containing 5 per cent silicon and 95 per cent aluminum as it has better corrosion resistance.

Oil Well Steel Scrap May Need Silicon Addition

We have an opportunity to secure a quantity of clippings from billets used in the manufacture of oil well drilling bits. This steel contains carbon 0.60 to 0.70 per cent and a slightly higher percentage of manganese. Is this material suitable for adding to No. 1 cast iron machinery scrap for making semisteel.

The scrap steel to which you refer is quite suitable as a component in a semisteel mixture. However, if you intend to use nothing else but machinery scrap, you will have to raise the silicon content for the thinner castings, either by the addition of briquets, ferrosilicon or high silicon pig iron.

Change Coke Ratio and Tuyere Arrangement in Small Cupola

We are melting 4-ton heats of hard iron in a 32-inch cupola equipped with two rows of four 3 x 5-inch tuyeres. After the eleventh tap the iron emits brown smoke and sparks and the casting contain pin holes. Fire is lighted at 1.15, blast on at 3.15 and blast off at 4.55.

The brown smoke and sparks indicate that the bed is too low and the iron is getting burned. You probably will have to readjust the relative proportions of coke and iron several times before you finally hit upon the ideal combination. Part of your trouble probably is due to the double row of tuyeres. For one reason the double row of tuyeres forces you to carry a much higher bed than would be necessary with a single row. For a second reason the lower row becomes partly choked early in the heat and as a result most of the wind enters the furnace through the upper tuyeres where it burns the iron, particularly if the bed is low. An extra charge of coke on the eighth or ninth charge will take care of that.

A single row of large tuyers, say four, 4 x 12-inches would serve satisfactorily and would save you a few hundred pounds of coke per day on the bed. Your present rate of melting, 4 tons in 1 hour, 40 minutes is rather slow for a 32-inch cupola and would seem to indicate that the bed is too high and melting is slow for the first part of the heat. Later this bed burns down too far and the intervening charges of coke are not sufficient to compensate for the loss.

Artificial Aging Gives Desired Results in Shorter Time

We have heard claims that some cast iron pistons used in diesel engines are allowed to age under atmospheric conditions for 2, 3 or perhaps 5 years before placed in service. The purpose of the aging process is to relieve any internal strains in the castings. Have you any information on the effect of that aging process?

Aging castings under atmospheric conditions to relieve casting strains was at one time practiced much more extensively than it is now, but we doubt, unless it was due to accident, that the period of exposure was much over 6 months. One reason is the fact that too much money would be tied up in castings. While to some extent that process may be practiced even now, it has been found that artificial aging gives the desired results without the long time interval. Artificial aging is nothing more than slowly heating the castings to a definite temperature for a definite length of time, and cooling slowly. Sometimes the castings are rough machined before being heated.

Casting strains may be relieved by placing the castings in a cold annealing furnace and heating up slowly to 900 degrees Fahr., holding at that temperature for a few hours to insure all parts becoming uniformly heated, and then cooling slowly. If easier machinability is wanted, the temperature is increased to 1400 degrees Fahr. However, with the higher temperature tensile strength is decreased somewhat and certain wear resisting properties also.

Beautiful mushroom type lighting units in front of the Planetarium at the Chicago Century of Progress. Illustration courtesy Westinghouse Electric & Mfg. Co.

Figure the Loss on Cored Boiler Castings

What is considered a fair percentage of loss on boiler castings, fire pots, dome sections and other castings of a like character?

Any statement on foundry loss is useless unless every factor is taken into consideration or unless the report distinctly specifies whether it refers to the total loss, the loss in defective castings, the furnace loss, or the amount represented by the gates, sprues, spills and over iron. All the metal represented in the difference in weight between the metal charged in the cupola and the amount shipped as salable castings, is not lost, in the sense that it has disappeared or is no longer available. The most of it still is in existence as return or shop scrap and the only real loss suffered in connection with it is the cost of melting and handling it twice instead of once.

If you refer to the percentage of loss as represented by defective castings, the limit of good practice is about 5 per cent. If defective castings, over a monthly period, exceed 5 per cent of the total number or weight of castings made, then decidedly the practice needs revision. In well conducted shops running on a standard line of castings, the loss usually is kept under 3 per cent.

Cement Is Used For Bonding Core Sand

We have been told that in some foundries, particularly brass shops producing small fittings, the core sand is bonded with cement. The cores are air dried instead of baked in an oven and are fit to use a few hours after they are turned out of the corebox.

The idea of using cement as a core binder and thus eliminating all core oven expense has attracted the attention of foundrymen for many years. Probably one of the first attempts was made by the late Dr. Moldenke many years ago and recorded in the chapter on core binders in *Principles of Iron Founding*. As a binder, he found cement quite satisfactory, but the reason he abandoned the use of the material is the same reason which has caused many other foundrymen to abandon it after a short trial. It wears the skin from the ends of the operators' fingers. Obviously a coremaker cannot wear gloves.

The situation is changed to a considerable extent where the cores are made on one of the types of core blowing machines now available. Here the operators' fingers are not subjected to intimate contact with the sand. Cement bonded cores have been tried extensively in several foundries and progress reports indicate that they have given satisfaction. In practice a typical mixture is made up of 8 parts sharp sand, 2 parts lean bank sand and 1 part cement. Cores made from this mixture usually are allowed to air dry for 24 hours before they are used.

Copper Is Added To Improve Composition

What is the best method for mixing copper with cast iron and semi-steel. What percentage of copper may be added. Is a mixture of this kind suitable for ammonia compressor and blank gear castings.

Effect of copper additions on the composition and physical properties of cast iron was described by C. T. Eddy in the February issue of THE FOUNDRY, the result of investigation carried on at the Michigan College of Mining and Technology, Houghton, Mich. The result of the investigation showed that copper in common with silicon and nickel decreases the tendency of cast iron to chilling. It assists the decomposition of primary cementite and prevents its formation. This effect of assisting graphitization together with the change of the pearlite to sorbite or a higher form in the matrix and the strengthening of the ferrite because of dissolved copper, results in a hard, strong iron, which because of the absence of free cementite, possesses good machinability.

Copper refines the austenite grains in addition to refining the graphite and improving the distribution. The combined effect is a gray iron of much closer texture since the pearlitic structure apparently is inherited from the austenitic grains. The metal shows a marked increase in brinell hardness and resistance to certain forms of corrosion. From the foregoing presentation one reasonably might infer that the metal is particularly adaptable for ammonia compressor, blank gear and other castings of a character which require a dense, solid structure. Copper to the extent of 2.50-2.75 per cent is added to the Ford cast crankshaft mixture. This amount probably represents the upper limit since the metal is hard and totally unmachinable until after it has been given a double heat treatment.

You will have to decide by experiment the proper amount to add to any given mixture to secure maximum results. The ideal manner of adding the copper is by placing the required amount with the remainder of the charge in an electric furnace. Small amounts of copper clippings or shot may be added to the metal in the ladle or in the cupola spout.

With ladle additions the alloying agent should be heated to as high a temperature as is practicable before placing in the ladle to prevent as much as possible, decrease in metal temperature. After the copper is added to the ladle be sure to stir the metal well to insure thorough incorporation.

Bronze Sleeve Is Cast Around Steel Rod

We pour a bronze sleeve approximately 12 inches in length around a 1-inch diameter wrought iron or steel rod. This bronze sleeve later is machined all over and serves as a bearing. It is held in place by contraction and by a shoulder on the steel rod. We have tried all the usual methods for insuring tranquility of the bronze as it surrounds the steel rod, but have only been partially successful. No method we have tried has produced all clean bronze sleeves, but in contrast to this record no method has produced all scrap sleeves. We have pickled the rods, sandblasted them, machined them, ground them and heated them to a cherry red and covered them with tar, with red lead, with kerosene and machine oil, with blacking and with shellac. Irrespective of which treatment is employed, some of the sleeves *kick back* from the steel rods.

The essential features of preventing *kick backs* when molten metal is poured around or against solid metal is to see that the latter is perfectly clean, and that it does not become damp. In some instances, the clean solid metal is placed in the mold cold, and poured immediately after closing without trouble. Usually, however, as an added precaution, the solid metal is warmed just to the point that it still can be handled comfortably, placed in the mold, and metal poured as soon as the mold is closed. It might be pointed out that cold metal in the damp molding sand condenses moisture rapidly. Hence the necessity of pouring in the molt en metal as soon as the mold is closed.

Various coatings that you mention are employed on solid metal around or against which molten metal is poured, but their purpose is to keep the solid metal clean, and to some extent forms an insulating jacket which reduces the tendency of condensing moisture. It is possible that in coating the rods with the materials mentioned that it was put on too thick or not dried thoroughly. Only thin, thoroughly dried coatings are of any value.

You mention that you have tried heating the rods a cherry red before placing them in the mold. At that temperature an oxide scale is formed as indicated in the sample you forwarded. Such scale is a prolific source of trouble from blowing or kicking. It is only necessary to heat them sufficiently to prevent condensation of moisture—that is slightly above the temperautre of the molding sand. If you see that the rods are as clean as it is practicable to make them, and that the molds containing the rods are not closed until just before pouring, you should not have trouble.

Viewing Foundry Developments

At Short Range

A DEVICE made up of two A-frames about 8 feet high with a connecting cross bar at the top, a suspended lever fork in the center and supported on four small wheels is employed in a prominent Mid-west foundry for shaking out stacked molds. The points of the fork are inserted under the top of the sprue. With the leverage supplied by a long handle the workman lifts the castings clear of the sand and deposits them in a truck. The A-frames are far enough apart to straddle the floors of stacked molds.

♦ ♦ ♦

Shrinkage factor of 3/16-inch per foot is used for magnesium castings of moderate size or with unrestrained shrinkage. A shrinkage factor of 5/32-inch per foot is advisable on large castings where free shrinkage is prevented by bosses or internal cores, according to the Dow Chemical Co.

♦ ♦ ♦

CHROMIUM alloy iron poured at high temperature was found to cut or wash the sand in the runner and gates of a small snap flask mold. To overcome this trouble, silica wash is sprayed over the runners and gates. To prevent any of this material from entering the mold cavities, a thin steel sheet is placed over the face of the mold. The sheet has an opening in the center sufficiently large to expose the gates and runner.

♦ ♦ ♦

Lining in the melting zone of the cupola must withstand temperatures as high as 2900 to 3100 degrees Fahr., and therefore highly refractory material is necessary, especially where long heats are run. Slag action is violent and the lining must be dense and well laid with as few narrow joints as possible. The lining must withstand spalling caused by extreme changes in temperature above the tuyeres and to rapid cooling to which it is subjected after the bottom is dropped. Therefore a high grade lining must be used.

♦ ♦ ♦

An English automobile company is spraying a thin layer of an aluminum base alloy on the internal surface of its combustion head. Advantages also found in an all aluminum head, are claimed for heads thus treated.

♦ ♦ ♦

THE height of the charge in the cupola may be measured at any time with a chain having a weight attached which is lowered into the stack from the charging door. A few simple calculations may be used to determine the amount of iron in the stack for different heights of charge. With this information a scale may be marked out on the charging floor so that the length of chain remaining when the weight is lowered in the stack to the charge will indicate at once the weight of iron in the cupola.

♦ ♦ ♦

A facing material to provide smooth and fine grained surfaces, free from pits, pinholes, etc., on castings, and which permits excellent peeling properties is composed of 100 parts of finely ground coke mixed intimately with 30 to 40 parts of crude molasses according to a patent. The molasses is sprayed on hot coke in a mixer and then dried at 110 to 120 degrees Cent. to remove moisture.

♦ ♦ ♦

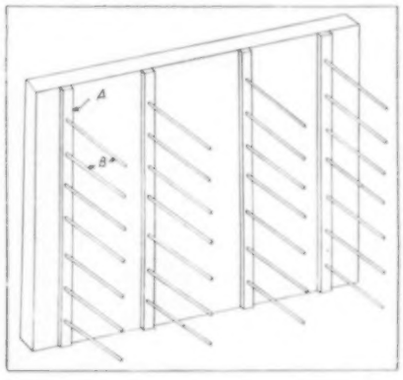
Aluminum alloys containing 0.5 to 5 per cent copper; 0.5 to 3 per cent nickel; 0.1 to 2.5 per cent magnesium; 0.2 to 2 per cent iron, and 0.2 to 2.5 per cent silicon are improved by the addition of up to 1 per cent cerium according to a British patent. Cerium may be added as an alloy, metal or flux composed of 10 to 20 per cent cerium oxide, 30 to 40 per cent barium nitrate, and 40 to 60 per cent sodium chloride.

♦ ♦ ♦

A 3-ton nickel cast iron melting pot for lead already has given 11 months' service and still is in use. A pot of unalloyed iron usually failed after approximately 6 months service. The cast iron analyzed: Total carbon 3.20; silicon 1.25; nickel 2.50 and chromium 0.50.

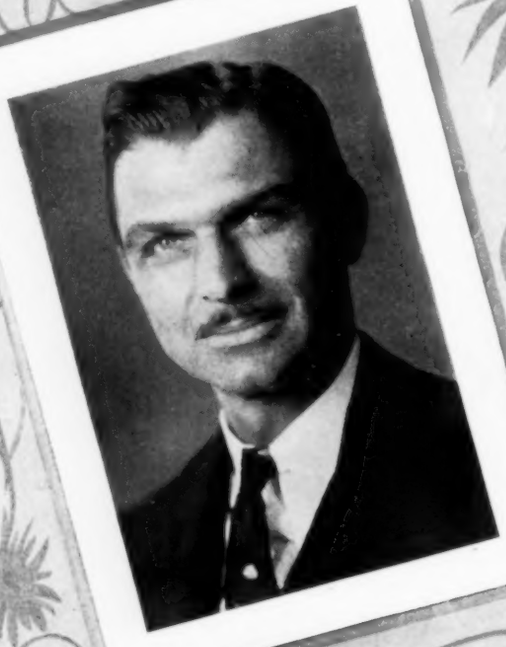
♦ ♦ ♦

SMALL castings poured from a sluggish quick-setting metal, made in snap flasks and poured in stack formation, developed small gas pockets on the top side. The foundryman diagnosed this defect as due to the inability of the gas to escape quickly



enough from the mold cavities. To overcome this trouble he attached the device shown in the accompanying illustration to the squeeze head of the molding machine. The pins *B* extend to a point approximately ⅛ inch above the ends of each pattern. The vent passing up through the openings left by these pins escapes through lateral openings left by the strips *A* in the upper side of the cope and under the bottom of the drag immediately on top.

The FOUNDRY Family Photograph Album



Upper Left
T. A. RENKENBERGER
Herman Pneumatic Machine Co., Pittsburgh

Upper Right
E. B. HAZEN
Brass Foundry Co., Peoria, Ill.

Lower Left
C. B. MAGRATH
North Western Foundry Co., Chicago

Lower Right
F. D. CLAUSEN
Van Brunt Mfg. Co., Horicon, Wis.

Men of Industry

Whose Activities Are Making Foundry History

RAY M. CHENEY, connected with the Vermont Snath Co., Springfield, Vt., since 1927, now is foundry superintendent of the Johnson & Jennings Co., Cleveland. Mr. Cheney has been associated with the foundry industry for many years and for 5 years was superintendent and manager of the Union Foundry Co., Fitchburg, Mass., and then was connected with the Metals Production Equipment Co., Springfield, Mass., for 2 years. Mr. Cheney left this firm to superintend the construction and equipping of the new Philbrick-Booth foundry at Hartford, Conn., where he remained for 2 years. At the outbreak of the war he became supervisor of all foundry operations for the E. B. Badger & Sons Co., Boston, which at times had 14 foundries engaged in producing gray iron, steel and bronze castings. He resigned from the Badger company in September, 1919, to become associated with the Angus Co. Ltd., Calcutta, India, where he remained 2½ years. On his return from India, Mr. Cheney became connected with the E. Arthur Tutein Inc., Boston, and in January, 1924, joined the H. & B. American Machine Co., Pawtucket, R. I.

Ray M. Cheney

CHARLES A. GOLDEN recently opened a pattern shop at 530½ Marietta street, N. W. Atlanta, Ga.

J. D. AGNEW has resigned his position with the Pittsburgh office of the Continental Roll & Steel Foundry Co., East Chicago, Ind. For the past 12 years, Mr. Agnew has been engaged in sales work with the Wheeling Mold & Foundry division of the Continental company.

C. E. WESTOVER has been appointed superintendent of the Burnside Steel Foundry Co., Chicago. Mr. Westover was graduated from the University of Nebraska in 1908 and took a post-graduat course in engineering until 1911. From boyhood he had worked in his father's foundry at Lincoln, and on finishing his college work, started in the foundry business. He operated his own iron foundry in Nebraska until 1923. He then became connected with the Omaha Steel Works, Omaha, Nebr., as superintendent. Later he was plant manager of the American Manganese Steel Co., Denver, Colo., superintendent of the Otis Elevator company's Steel Foundry, Buffalo, N. Y., and for almost five years superintendent of the Farrell-Cheek Steel Foundry Co., Sandusky, O.

J. C. CHAMPION recently has been made foundry superintendent of the Ohio Cultivator Co., Bellvue, O. Mr. Champion formerly was foundry superintendent of the C. & G. Cooper Co., now the Cooper-Bessemer Corp. Mt. Vernon, O., the Electric Auto-Lite Foundry Co., Fostoria, O., and the Lorain Castings Co., Lorain, O.

G. N. HERMAN, recently made vice president of the Hubbard Steel Foundry division, Continental Roll & Steel Foundry Co., East Chicago, Ind., has been elected vice president and general manager of sales of the Continental company. Mr. Herman has been identified with the steel and steel mill equipment field for a number of years, previously having been western representative for the United Engineering & Foundry Co., Pittsburgh. Prior to this connection he was associated with SKF Industries Inc. at Chicago.

J. S. MOHR has been appointed manager of sales of the Hubbard Steel Foundry division, Continental Roll & Steel Foundry Co. Mr. Mohr attended the University of Illinois where he studied mechanical engineering. Since 1921 he had been associated with John Mohr & Sons, Chicago, manufacturers of hot stoves, metal mixers and other steel plant equipment.

WILLIAM F. PATTERSON, director of vocational guidance and employment, Milwaukee Vocational school, Milwaukee for the past 8 years, has been granted a leave of absence to accept appointment by Secretary of Labor, Frances Perkins, as executive secretary of the federal committee on apprentice training.

J. C. REDMOND, formerly connected with the bureau of standards, Washington, has joined the staff of the Battelle Memorial institute, Columbus, O., as assistant analytical chemist.

WILLIAM MILLER, senior vice president, Pyle-National Co., Chicago, manufacturer of railroad supplies, has been elected president succeeding the late L. H. Vilas.

Sales Representative

Case Hardening Service Co., Cleveland, recently has been appointed sales representative for the Detroit Electric Furnace Co., Detroit, and will handle the new rocking electric furnace recently developed. The new furnace includes automatic timing mechanism which changes the angle of rock without operating attention.

W. C. Bell is president of the Case Hardening Service Co.

Reader's Comment

Interesting communications from readers of The Foundry

EDITOR'S NOTE — *Material Appearing Under this Head Does Not Necessarily Reflect the Opinion of* THE FOUNDRY *or of Its Editors.*

Voices Approval

TO THE EDITORS:

Your editorial in the August issue of THE FOUNDRY, "Uncle Sam Nurse Maid," prompts me to write and voice my enthusiastic approval of the thought as well as the spirit expressed therein. I wish it might be broadcast for the digest of many who do not take an interest in the foundry industry, but have much to do with the Government and the NRA.

I think editors of our trade journals who are sufficiently practical in their chosen fields are offering some valuable thoughts that the general public would find enlightening if they took the time to read them or were so situated as to have them reach their attention.

I think we are all wondering just what will be the final outcome of the experimenting that is going on today. Certainly the history of government meddling in business and bureaucratic control of certain phases of industrial life are developing a lack of confidence in the future of industry that is throttling the life of industry, since capital is hunting for other fields to cultivate. Without the interest of capital in industry, industry must languish and I think that is exactly what is happening right now. There was a spurt due to the optimism of industrialists when they thought they could improve their condition by codification and the plans of codification were such that optimism was warranted.

Now we are faced with codified industries subject to delay, special edicts from Washington, rules and regulations offered without proper study or conference with those in industry who should be best informed as to their prospective usefulness. Thus I think Washington is feeling around or searching for the next move to make and doing so very blindly.

Why does not Washington say to industry—"We have helped you to codify your industry and given you the power legally to operate your industry on a mutually beneficial basis. We are now going to declare a policy of hands off for a sufficient length of time to enable you to put your several industrial houses in order under this codified condition and shall look for the real solid benefits to industry, to unemployment problems, to industrial recovery that codification promised and can surely produce if it is handled by those who are best versed in the industry and certainly those who are the best versed are industrialists themselves."

I wish there were some way to have Washington realize that there is nothing that is retarding recovery more than vacillation of Washington and the consequent lack of security. Those of us who are concerned with the administration of codes are trying earnestly to make those codes effective and thereby reap the harvest of improved conditions for employer and employe that could be secured but for the changing policies and interpretations that come from Washington. Codification is either going to be a flat failure because of Washington's mistakes and interference or else industry has got to get such benefits as it can from the time and expense that is put into codification by constantly battling with Washington instead of co-operating.

I would like to hear what your thoughts are on the above and what we can do to combat the evils, some of which I have outlined.

MEMBER, CODE AUTHORITY.

Always a Reader

TO THE EDITORS:

Your cover article, "Young Man What Now?" is true in every sense of the word. The writer subscribed to the first issue of THE FOUNDRY, and studied it from cover to cover year after year—Result: from a poor molder's son to superintendent of one of our largest foundries, refusing an offered position at $10,000 per year and many smaller positions. Today, I own my own foundry without any assistance from any one. My foundry has no debts other than a few minor accounts from month to month. I owe my foundry knowledge to your monthly, THE FOUNDRY.

To show you how nervous I am after 50 years in a foundry here is a sample of steady nerves, written August 20, 1934, height of letters average 15 mm. of an inch. The circle is a penny; subject: the Lord's Prayer. Tell—the young man—he can do likewise.

J. W. DUBOIS

J. W. DuBois Foundry
Cold Spring on Hudson
New York

EDITOR'S NOTE — The exhibition of small writing submitted by Mr. DuBois is remarkable. A reading glass shows the writing, covering just a trifle more than half the surface of a penny, is almost perfect in detail

Congratulations

TO THE EDITORS:

I congratulate you and the Penton Publishing Co. on the text on the front cover of the August number. This is most timely, the most instructive and truthful story ever printed for the benefit of young men and the foundry industry.

It is a CLASSIC, and I feel positive that it will more than repay the Penton company for the space, which no doubt, would have sold for quite a sum.

DAVID MCLAIN

McLain's System Inc.
Milwaukee,

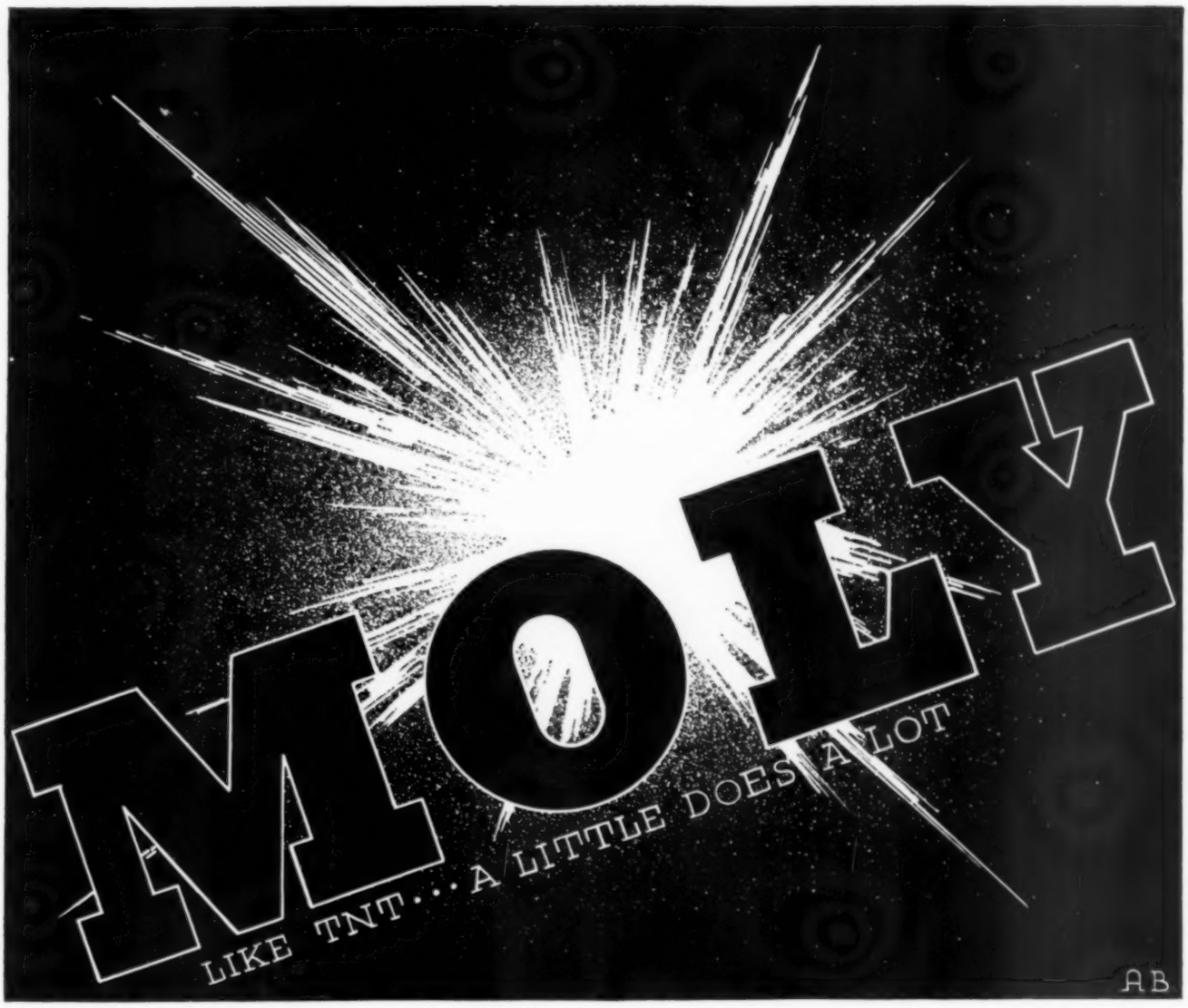
Amends Code of Steel Castings Industry

National Recovery Administrator Hugh S. Johnson on Aug. 24 announced approval of amendments to the code of fair competition for the steel castings industry. One amendment provides that no agency or subdivision shall sell or offer to sell any product at a price lower than the price filed by a member of such agency or subdivision.

Another amendment provides for the addition of several unfair trade practices to schedule "D" of the approved code, relating only to miscellaneous castings. The modifications were scheduled to become effective 15 days from date of approval.

Approves Foundry Equipment Code Authority

National Recovery administration on Aug. 22 approved the code authority of the foundry equipment industry as follows: Chairman S. C. Vessy, W. W. Sly Mfg. Co., Cleveland; R. S. Hammond, Whiting Corp., Harvey, Ill.; F. R. Wallace, Tabor Mfg. Co., Philadelphia; E. O. Beardsley, Beardsley & Piper Co., Chicago; T. W. Pangborn, Pangborn Corp., Hagerstown, Md.; D. A. Weber, Deister Concentrator Co., Ft. Wayne, Ind.; E. A. Pridmore, International Molding Machine Co., Chicago; V. E. Minich, American Foundry Equipment Co., Mishawaka, Ind.; and H. S. Simpson, National Engineering Co., Chicago.



WHETHER it be toward the application of strength or the resistance to shock or wear, any added element which justifies its cost is usually welcome. "Moly" in iron or steel does more than that.

Example: A small amount of Molybdenum, when added to cast iron, will increase its wear resistance to an extent that far outweighs the added cost. The following comparison of wear, as measured on the Amsler Machine, brings out this effect:

	Loss in weight per sq. cm. *after* 105,000 *cycles*
Plain Iron	7.3 grams
Molybdenum Iron (1% Mo.) . .	1.0 "

By the same token, Moly increases the strength (tensile and creep) of iron or steel. It reduces temper embrittlement—increases toughness, without loss of hardness. It actually enhances the characteristics of other alloys. Yet it makes for easier machinability, forging and welding. Paradoxical? It seems so. But Moly qualities are no longer theories. Instances without number have proved them.

The story of Molybdenum grows bigger and bigger as new applications and analyses come to light. Toward keeping executives and engineers informed of such progress, we publish a house organ, "*The Moly Matrix*," which we will gladly mail to you regularly on request. Write also for these interesting new books: "*Molybdenum in* 1934" and "*Molybdenum in Cast Iron*—1934 *Supplement*." Toward the solving of any alloy problems peculiar to your particular needs or products we invite you to consult our metallurgists and to make use of our modern experimental laboratories in Detroit. Climax Molybdenum Company, 295 Madison Avenue, New York.

CLIMAX Mo-lyb-den-um

Prevent Losses with

Proper Gates and Risers

BY PAT DWYER

GENERAL character of the castings determines the proper pouring temperature of molten steel and this in turn to a certain extent regulates the proper size and position of the gate on any given casting. Practical experience and intensive observation for an extended period and under varying conditions constitute the most reliable guide in this respect. After the steel foundryman has determined the best location for the gate, he must then consider the shrinkage problem. Molten steel in passing from the liquid to the solid form shrinks from 3/16 to ¼-inch per foot. Therefore the foundryman must provide practically all forms of steel castings with a reservoir or feeder to compensate for the shrinkage and to insure a solid casting. A green sand mold cools or chills the steel more rapidly than a dry sand mold, consequently the amount or volume of metal in a green sand head is less than in a dry sand head.

Shrinkage Experiments

An extended series of experiments to determine this and other related features in the shrinkage of various types of steel castings was described by R. H. West in a paper *Gates and Heads on Steel Castings*, Vol. XXV *Transactions* of the American Foundrymens association. Since the shrinkage problem varies according to the shape and form of the casting and according to variations in the section, he presented several standard forms of test bars to illustrate shrinkage phenomena. These test bars were molded both in green and in dry sand. They were poured from the top without any gate and with no extra head. A marked variation, due to the different cooling or chilling effect of the mold was noted between tests poured in green sand and corresponding tests poured in dry sand molds.

In a plain bar of approximately uniform cross section, the casting poured in a dry sand mold showed a small shrinkage cavity a few inches below the top. The test bar poured in green sand was solid throughout. Comparing the results from a wide variety of shapes indicated that feeding of some kind is required on all sections over 1-inch in thickness. Results also showed that shrinkage culminates at or near the top of all properly molded and poured castings.

A second series of tests covered standard test bars with different forms of heads usually found in all steel foundries. Duplicate sets were cast in green and in dry sand. Dimensions and shapes of the various heads are shown in Fig. 244. The test bar *M* contains 32 cubic inches, head *A* 28 cubic inches, *B* and *D*, 10 cubic inches, *C*, 12.5 cubic inches, *E*, 20.25 cubic inches and head *F*, 9 cubic inches.

As in the previous test the bars cast in green sand show greater solidity than the bars cast in dry sand molds. Only two bars, *A* and *E* could be considered as really satisfactory. The head on *A* is considerably in excess of actual requiremen and might be reduced with perfect safety to the size shown at *E*, which might be accepted as the required standard. In this bar the ratio of head to casting is as 20 cubic inches is to 32 cubic inches, or 38 per cent steel in the head to 62 per cent in the casting. This may be regarded as a fair average for the ordinary miscellaneous general jobbing foundry. With the exception of an occasional *whistler*, risers practically have been eliminated in light casting specialty shops and in the production shops catering to the railroads. These foundries have developed methods of producing steel castings peculiar to their own requirements in green sand. Internal and external chills take care of minor shrinkage problems.

Methods of gating and heading several rather unusual castings are shown in Figs. 245, 246 and 247. The cylindrical casting Fig. 245 is to be finished all over. Teeth are cut in the upper end to form a pinion and the lower end is a friction surface for a brake. So far as molding is concerned, the shape of the casting is fairly simple and lends itself readily to either horizontal or vertical treatment. Possibly a fairly satisfactory casting could be secured from a horizontal mold fed from three risers but on the broad general principle that gravity is an important factor in feeding a casting, the vertical method of molding the casting seems preferable in this instance. The long sprue carries the metal to the lower end of the mold where it enters the mold cavity through a horizontal gate passage pinched in the center to prevent the heavy sprue from tearing a piece out of the flange of the casting during contraction of the metal.

Protect Feeding Head

In a second precautionary measure, the molder must dig away the sand around the feeding head to prevent a check or crack in the casting below the top shoulder. In some instances it is advisable to place a sectional chill ring at the shoulder as shown in the illustration. In other instances, where a chill might interfere with the ready passage of feeding metal from the upper to the lower part of the casting, the chill must be omitted. For the same reason where the center section freezes before the heavy bottom section it will be necessary to place a supplementary side feeding head on the lower part of

(*Continued on page 40*)

Typical Cases

WHILE oral or written instruction presents a certain amount of information to the hearer or reader, it can be appreciated fully only by the man with a background of practical experience and who therefore is in a position to adapt the information intelligently to any one of his own specific problems. Rules of procedure for a casting produced in a dry sand mold are modified to a certain extent when the same casting is made in a green sand mold. Green sand yields more readily than dry sand to the contraction of the casting. The metal cools more rapidly and therefore eliminates or reduces the sizes of the risers in many instances. Since contraction of the casting causes the metal to sink vertically, many castings become self feeders to a certain extent when cast in a vertical instead of the usual horizontal position.

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3. Cohesiveness—green strength to make molding safe and easy; dry strength to resist destructive action of heat and metal flow.
4. Permeability—permitting escape of gases.
5. Refractoriness—a high sintering point makes for easy peeling castings and resistance to mold penetration by molten metal.
6. Durability—clay composition and grain structure; for frequent re-use and sand economy.

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Write us—TODAY.

(*Continued from page* 38)

the casting. Side risers, for reasons mentioned previously are not as efficient as risers placed directly on top and should not be employed except in emergencies. In the instance cited, the proper method to adopt is to increase the metal thickness in the center section, even if it involves extra machine work later.

A magnet frame 24 inches diameter, 12 inches high with 1½-inch thickness of metal and with several exterior and interior bosses is typical of this general class of shell castings. Satisfactory castings are made by pouring the metal through a gate at the bottom and with three 3½-inch diameter heads, 6 inches high spaced equidistantly on the top of the rim. A smaller head is placed on top of the pole pieces at one side. Where the poles are concealed below the top section, the metal is chilled by nails on the inside or by external chills held in place by the sand on the outside.

Directing The Gate

The gate is located as near the bottom as possible and pointed in a direction that will prevent the metal from cutting or washing the sand on the core or inside part of the mold. In nearly all castings of this kind it is necessary to dig out the sand in the interior of the mold after the metal has set. Usually in making the mold an opening is formed in the center of the core. In some instances this opening will allow the sand to contact with the casting. In other instances it is necessary to remove additional sand to facilitate contraction. Some foundrymen favor the practice of filling the opening in the core with water to soften the sand. This practice which also extends to the sand surrounding large risers seems to find greater favor in European countries than in America and was touched upon in the controversy

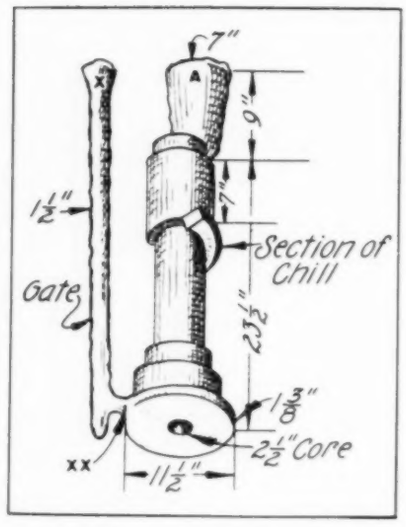


Fig. 245—The chill at the neck will interfere with the feeding

which followed the publication of a report by Capt. Louis Shane, United States navy covering his observations on European steel foundry practice (THE FOUNDRY, page 18, October, and page 30, December, 1933).

Two methods for casting heavy blank pinions, one horizontal and the other vertical, are shown in Figs. 246 and 247. Where other conditions are equal, either method will produce a clean, solid casting. Where the casting is molded in a flask the method shown in Fig. 246 is the simpler of the two, but the amount of metal required in the risers to feed the casting efficiently is more than double the amount required by the second method where the casting itself is a self feeder. Therefore, while the method shown in Fig. 246 would be the cheaper for a single casting, the method shown in Fig. 247 would be more economical on several castings. Extended reference to molding and casting wheels and disks in a vertical position was included in No. 51 of the present series (THE FOUNDRY, April, 1934).

The blank double gear shown in Figs. 248 and 249 introduces an additional hazard, since success in one part may be gained at a sacrifice in the other part. Extended experience would seem to indicate that the method shown in Fig. 248 for heading and gating the casting is the more satisfactory of the two. Each gear section is fed independently of the other. In the method shown in Fig. 249 the resulting casting almost invariably will disclose shrinkage cavities at the root of some of the teeth. Also, the reduced amount of metal in the heads is a factor in favor of the method shown in Fig. 248.

A common form of casting with a bearing section connecting a ribbed or box section is shown in Fig. 250. Usually trouble is experienced in securing solid metal at the shoulder *B*. If the metal section at this point is not sufficient to feed the lower part of the casting, the foundryman should not hesitate to direct this feature to the attention of the designer or customer with a request for the necessary change. Temporary and apparent relief may be had by placing chills at this junction point, but the chills prevent the passage of feeding metal to the lower part and the resulting casting will not be as strong, homogenous and solid as should be.

Two methods of molding a chunky casting designed to be finished all over and in which solid metal is required throughout, are shown in Figs. 251 and 252. In the first method the mold is gated at or near the top and the metal falls on to a chill at the bottom. Thus the ideal condition is obtained where the metal cools gradually from the bottom, and the hot metal enters the top and also flows up into the feeding head. Also, a minimum amount of metal in the head, approximately 20 per cent of the weight of metal in the casting, will feed the casting adequately. In the second method shown in Fig. 252 the casting is gated at or near the bottom. Conditions are reversed to the extent that the hottest metal is at the bottom and the coldest metal is at the top at the conclusion of the pouring operation. Consequently a much larger feeding head is required. The only explanation of this wasteful practice is that some foundrymen are wedded firmly to the tradition that all large castings, particularly those molded in dry sand, must be gated at the bottom.

Pour Metal Slowly

Perfectly solid steel castings, particularly castings in which the thickness of metal is fairly uniform, are produced by pouring the metal slowly so that solidification progresses

(*Concluded on page* 43)

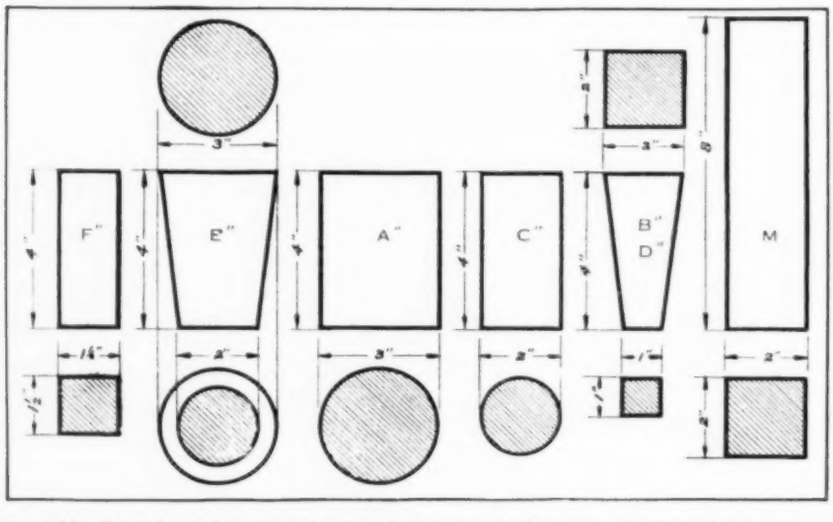


Fig. 244—In this series of tests the shrink head E approached perfection more nearly than any of the others

ADVERTISING PAGES REMOVED

(*Concluded from page 40*)

steadily from the bottom and ceases practically at the moment the last metal is poured into the mold. In certain instances the metal must be introduced at the bottom and other methods must be practiced to secure solid metal as in the sleeve casting shown in Fig. 253. In this instance fairly satisfactory results may be secured by placing a feeder on top and a ring of external chills under the collar.

Steel castings production hinges on the most complete co-ordination between the methods and operations of the molder and melter. The slightest inattention to detail on the part of either one, nullifies the best efforts of the other. From the following list originally compiled by Michael R. Burns and presented in THE FOUNDRY several years ago, it will be noted that the faults due to omission are about equal to those due to commission. While many may be included in the preventable class, a considerale number still are in that vague category usually referred to as causes beyond our control.

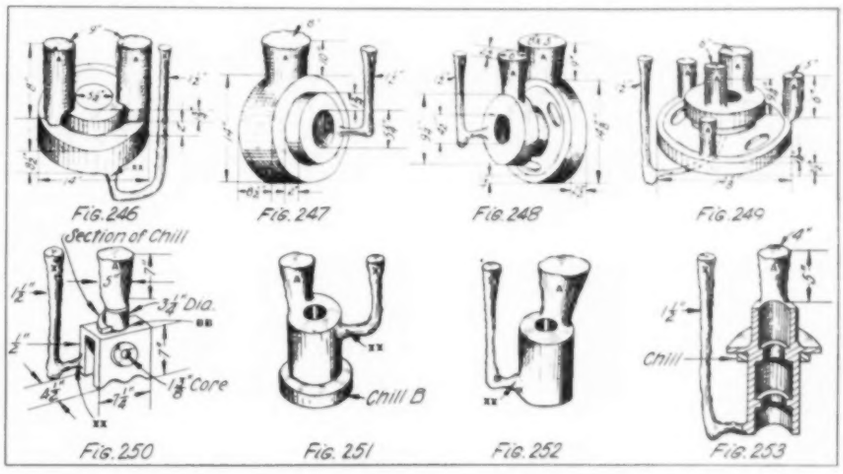
1.—Work done by careless or incompetent molder.
2.—Unsuitable facing sand.
3.—Green sand molds rammed too hard.
4.—Green sand molds rammed too soft.
5.—Molds not vented properly.
6.—Molds not dried sufficiently.
7.—Molds over dried and burned.
8.—Dry molds not properly loaded.
9.—Molds shifted in closing.
10.—Chaplets too few, too small or not properly secured.
11.—Use of defective flasks.
12.—For want of gaggers or other support sand drops after mold is closed.
13.—Insufficient or careless clamping resulting in a runout.
14.—Guessing at the volume of metal in a ladle and pouring a mold short.
15.—Gates injudiciously placed.
16.—Heads not in proper places.
17.—Fillets too small.
18.—Heads too small to feed casting.
19.—Heads so large they crack small castings.
20.—Trying to make long castings in dry instead of green sand molds.
21.—Molder not instructed where to cut brackets.
22.—Hard cores which crack castings.
23.—Soft cores which cut away in large heavy castings.
24.—Cores not properly rodded to resist pressure of metal.
25.—Cores not vented in a suitable manner.
26.—Half cores not pasted securely together. Where rod only appears in one half, the molder sometimes places core in the mold with unsupported side down with the result that it drops off.
27.—Cores only partly dried.
28.—Burned cores on which molder takes a chance
29.—Unsuitable core sand mixture.
30.—Silica wash applied too thickly; chips and comes to surface of casting.
31.—Slag in metal.
32.—Metal which is duller than it appears.
33.—Metal poured too fast which strains mold, or poured too slow and does not run casting.
34.—Omitting to feed a casting which requires such treatment.
35.—Ignorance of feeding methods on part of operator.
36.—Omitting to nail certain surfaces on green sand molds.
37.—Omitting to put horse shoe nails in small hubs.
38.—Placing rusty nails in mold.
39.—Omitting tinned rods at points where segregation or cracks otherwise will appear.
40.—Use of rusty rods.
41.—Dumping molds before metal has set.
42.—Omitting to dig around heads after casting is poured to provide for contraction.
43.—Omitting to dig out cores in certain cases promptly.
44.—Taking a chance with a shallow drag. Usually results either in a scabbed casting or a runout.
45.—Half patterns not matched accurately on machines.
46.—Loose pins which result in mismatched castings.
47.—Worn pin holes, same result.
48.—Leaving copes standing too long on one side resulting in distortion.
49.—Green helpers placing weights on molds frequently knock sand down runners and feeding head openings.
50.—Core prints not sufficiently definite in some cases to locate in proper relative position.

This is the fifty-sixth of a series of articles dealing with the various types of gates and risers used in the foundry industry. The fifty-seventh will appear in an early issue.— The Editors.

Several Factors Govern Clapper Size

Bell founders all have their own design of bells. Some makers design thick sections where the hammers strike, while others are much thinner for the same size and weight of bell. Obviously the thinner bells cannot be struck with as heavy hammers as the thicker bells. One manufacturer uses clappers that are pear shaped. The largest diameter is twice the thickness of the bell at the striking spot. Thus where a bell is 4 inches thick at the striking point, the pear shaped clapper is 8 inches at the largest diameter. The length of stroke, and intensity of the blow given a bell, has considerable to do with the size of the hammer which is used.

Bell founders use many and varied weight and size clappers on bells of the same weight. One founder has more than doubled the weight and size of the clapper normally used, but has made the stroke very short. Bell hammers and clappers are made of many materials, cast iron, wrought iron, malleable iron and bronze. Under normal conditions, a pear shaped clapper with its largest diameter twice the thickness of the striking area on the bell, will give the best results. In individual installations, location, distance the bell is desired to be heard and intensity of tone desired, are considered when making clappers for bells.



Figs. 246-249—A considerable saving in riser metal may be effected by pouring disk castings on edge. Fig. 250—Chill at the neck prevents the head from feeding properly. Fig. 251—Requires less feeding metal than Fig. 252. Fig. 253—In this casting the metal should be poured slowly

Plan General Nonferrous Conference

The Nonferrous Foundry Association for Industrial Recovery is holding a three day industry meeting in Chicago, Wednesday, Thursday, and Friday, Sept. 19 to 21. The first two days will be devoted to discussion of trade problems, the new cost system adopted by the association, which appears on page 19 of THE FOUNDRY, and an open forum for a discussion of code matters.

A new classification by which nonferrous castings are to be assigned for cost estimating and pricing purposes has been prepared. Supplemental codes relating to miscellaneous sand castings and to steel and rolling mill castings specifically forbid flat price per pound quotations. The new classification will permit greater uniformity in determining variations in castings as related to pattern equipment, weight, intricacies, and other factors.

Elections have been conducted by various district organizations of the Nonferrous Foundry association, and directors and alternates chosen are as follows:

District No. 1: Director, J. A. Duncan, William Duncan Co., East Boston, Mass.; Alternate Director, Sidney K. Becker, U. S. Aluminum Co., Fairfield, Conn.

District No. 2: Director, Charles E. Schley, Philadelphia Brass & Bronze Corp., Philadelphia.

District No. 3: Director, Thomas S. Hemenway, Metal & Alloy Specialties Co., Buffalo; Alternate Director, A. W. Cadman, A. W. Cadman Mfg. Co., Pittsburgh.

District No. 4: Director, J. P. Jefferis, Shenango-Penn Mold Co., Dover, O.; Alternate Director, F. S. Wellman, Wellman Bronze & Aluminum Co., Cleveland.

District No. 5: Director, Edward Goldman, United Brass & Aluminum Co., Port Huron, Mich.; Alternate Director, Vaughan Reid, City Pattern Works, Detroit.

District No. 6: Director, F. L. Hayes, Chicago Hardware Foundry Co., Chicago; Alternate Director, F. N. Flynn, Arthur Harris & Co., Chicago.

District No. 7: Director, George B. Miller, Loeffelholz Co., Milwaukee; Alternate Director, Roy Jacobs, Standard Brass Works, Milwaukee.

District No. 8: Director, Charles Wegelin, Dixie Bronze Co., Birmingham, Ala.; Alternate Director, N. Wootton, Kingsport Foundry & Mfg. Corp., Kingsport, Tenn.

District No. 9: Director, William L. Heckmann, National Art Bronze Works Co., St. Louis; Alternate Director, Elmer Koester, Mueller Brass Foundry Co., St. Louis.

District No. 10: Director, Maurice S. Greenberg, M. Greenberg's Sons, San Francisco; Alternate Director, Fred Czerniski, Magnus Co., Inc., Los Angeles.

Makes Large Generator Casting

(*Concluded from page 29*)

to facilitate contraction.

Actual pouring of the metal occupied 4 minutes. Six hours later sand was broken away from around the risers. The following night the arbors in many of the cores were released by burning the bolts with a torch. The casting then was allowed to lie in the mold for two weeks so that the cooling should be as slow and gradual as possible. In this manner the hazards of warpage and contraction incident to sudden and violent change in temperature were obviated. As may be noted in the illustration the casting presented a smooth, clean surface free from cracks, scabs, buckles, swells or other blemishes.

Due to the large volume of metal involved and the extended area to be covered, 17 inlet gates were provided on each of the two long sides. Shallow stumps of the gates may be seen in Fig. 2. They were spaced approximately 3 feet apart and followed the contour of the casting, a vertical row near each end and a curved row around the semicircular opening extending through the casting from side to side. This arrangement insured a rapid and uniform distribution of the molten metal and a consequent approximate uniform temperature throughout the entire casting. Risers were placed on top and at several places on the side near the top. The weight of the 20 risers aggregated 24,000 pounds and approximately 8000 pounds of metal were used in feeding the casting.

Clay tiles 3 inches in diameter and 9 inches in length and provided with male and female joints were incorporated in the sand walls of the mold to form the gates and runners. The runners extended upward to a basin which extended the full length of the mold at each side. The metal was poured from five ladles, two containing 55,000 pounds each, two with 40,000 pounds each and one containing 20,000 pounds. The ladles were handled by three cranes, one over each end of the mold and one over the center. One ladle was set at each corner of the mold and one at the center of one side. Metal from two end ladles, one at each side, was poured first. Then the metal from the center ladle was employed to keep the pouring basin filled while the end cranes dropped the empty ladles and picked up the two remaining ladles to complete the pouring.

Becomes Partner In Pig Iron Sales Firm

E. A. Bateman, associated with Pickands, Brown & Co., in their Chicago office since 1904, has resigned to become a partner in the firm of Bauer-Wilson & Bateman, 310 South Michigan avenue, Chicago, sales agents for low phosphorus and charcoal pig iron, alloys, fluorspar and foundry coke.

Describes Test

The Engineering Experiment station, University of Illinois, Urbana, Ill., recently has published circular No. 23 and "Repeated-Stress (Fatigue) Testing Machines Used in the Materials Testing Laboratory of the University of Illinois." by Herbert F. Moore and Glen N. Krouse. The machines described include various types for making fatigue tests in repeated flexure, in direct tension and compression, and in torsion.

Code Authorities Related To The Foundry Industry

Industry	Address
Alloy Casting	7 East Forty-fourth street, New York.
Automobile Manufacturing	366 Madison avenue, New York.
Automotive Parts and Equipment	General Motors building, Detroit.
Cast Iron Boiler and Radiator	29 Seneca street, Geneva, N. Y.
Cast Iron Soil Pipe	1501 Empire building, Birmingham, Ala.
Cast Iron Pressure Pipe	Earl building, Washington.
Chilled Car Wheel	1847 McCormick building, Chicago.
Die-Casting Manufacturing	505 Arch street, Philadelphia.
Foundry Equipment	1213 West Third street, Cleveland.
Foundry Supply	19 West Forty-fourth street, New York.
Gray Iron Foundry	Public Square building, Cleveland.
Industrial Furnaces	5 East Eighth street, Holland, Mich.
Malleable Iron Foundry	Union Trust building, Cleveland.
Nonferrous Foundry	47 Fulton street, New York.
Railway Brass Car Bearings, Locomotive Journal Bearings and Castings Manufacturing	208 South LaSalle street, Chicago.
Steel Castings	420 Lexington avenue, New York.
Valve and Fittings Manufacturing	420 Lexington avenue, New York.
Warm Air Furnace Manufacturing	Farmers Bank building, Pittsburgh.

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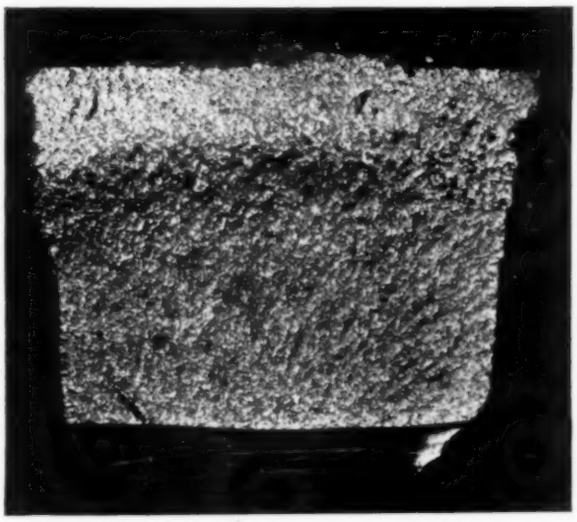
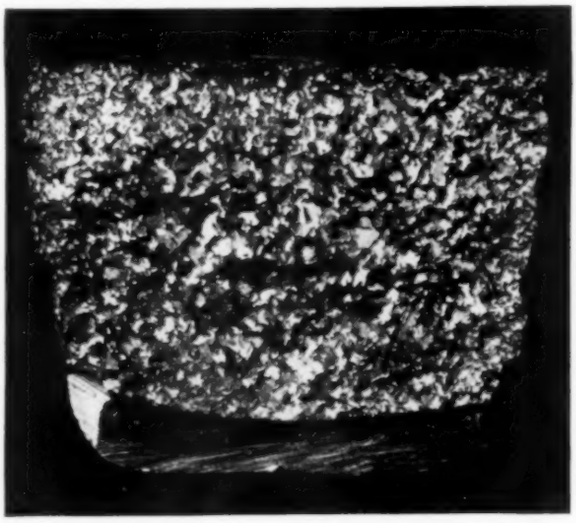


The fine grained structure of this fractured cast steel clearly indicates the effect of nitrogen. This cast steel contains 27.35 per cent chromium, 0.56 per cent carbon, 0.34 per cent nickel and 0.32 per cent nitrogen.



This coarse grained structure is that of a fractured cast steel containing only a trace of nitrogen. Analysis shows 27.85 per cent chromium, 0.50 per cent carbon, 0.75 per cent nickel and 0.06 per cent nitrogen.

★ Grain refinement of high chromium steels can be obtained by the addition of small percentages of nitrogen in the form of High Nitrogen Ferrochrome.

Castings for valves, pumps and fittings that are subjected to extremely corrosive conditions must combine corrosion resistance with strength and toughness. The use of steels containing over 20 per cent chromium gives the necessary corrosion resistance. Castings with high chromium content often have coarse grain structure and lack desired toughness. Nitrogen introduced with the chromium refines the grain and develops the inherent strength and toughness of the metal. The proper ratio of nitrogen to chromium is contained in a single Electromet alloy offered as High Nitrogen Ferrochrome which can be introduced into the castings by furnace additions.

Write today for more detailed information. If you wish, one of our service metallurgists will gladly call.

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Pave Roads with Cast Iron Blocks

(*Continued from Page 25*)

would be almost negligible for many years to come." Another reports that in snowy and icy weather the cast iron road surface is noticeably safer than other types of roads.

Cast iron blocks and the special mastic for laying are delivered to the paving job in England at a cost of 16 to 18 shillings per square yard, and the labor for laying amounts to about 2 shillings per square yard. This gives a total cost for the finished surface of 18 to 20 shillings, or about $5 per square yard. The cost of the cast iron blocks alone is about 14 shillings, or $3.50 per square yard, and since a square yard of blocks will weigh about 235 pounds, the cost of the castings is about $30 per ton. Cost of foundry iron in England is about $17 per ton against a cost in this country of about $19.

Harden the Surface

No special alloys are added to the iron. The studs themselves are in some cases hardened, but the castings are of a simple nature and no unusual foundry practice is required in their manufacture. One English company advertises that it will surface concrete paving with these cast iron blocks and take care of all maintenance for 10 years at a total cost of 18 shillings per square yard. As a basis for comparison, first-class brick surfacing costs about $2.50 per square yard in Minneapolis.

The second system of paving used to some extent in England consists in laying 12-inch square perforated and ribbed cast iron plates directly on a base of gravel or crushed rock. These plates, of an interlocking type, weigh approximately 13 pounds each and are made by the Shotts Iron Co., Edinburgh. After the plates are laid and lightly tamped into place, tarred macadam or asphalt mastic is rolled on as a surfacing. These plates are 5/16-inch thick with ribs 7/16-inch high. They are laid with the ribs up and will support a concentrated load of 4 tons under the most adverse conditions. It is claimed that this type of pavement is less expensive than concrete pavement with asphalt surfacing and will outlast this type considerably.

In Germany the Schmid-Laufach system of road construction, using an open honeycomb cast iron grid, has been in use for some time. The grid sections, about one-third of a meter square and interlocking, are laid directly on a sub-base of crushed rock or gravel. They are tamped lightly into place and then the openings in the grids are filled with tarred rock, concrete, or asphalt mastic. This material is rolled or tamped into place and the pavement is ready for use. With wear, the filling material is depressed slightly between the honeycomb sections, which are about 5 inches wide, leaving the cast iron edges slightly protruding and thus making a skid-proof surface.

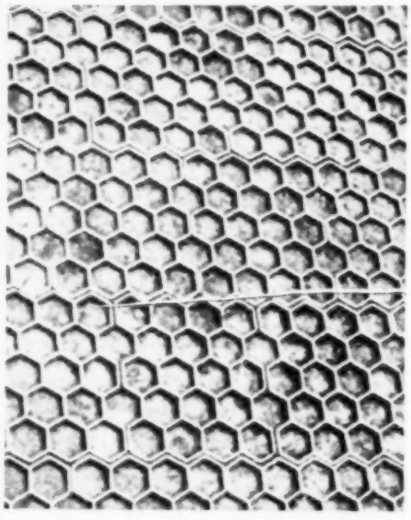

Fig. 5—A Schmid-Laufach cast iron honeycomb grid foundation before the mastic is applied

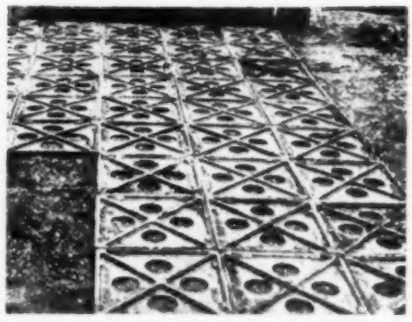

Fig. 6—Cast iron foundation plates, a product of Shotts Iron Co. These will be covered with mastic

Sections of this type of roadway have withstood the most severe traffic conditions for 1½ years under weather conditions that cause great damage to other types of pavements. Total cost of installing this type of road surfacing is stated to be about 5.50 reichsmarks per square meter, or about $2.10 at the present rate of exchange. These grids now are being made 3.28 feet wide and as long as the traveled surface is wide, and are laid directly on the shaped subgrade.

France Plans Highway

In France considerable attention has been given to the use of cast iron in highway construction . In 1926 it was proposed to surface a highway from Paris to Marseilles, a distance of 800 kilometers (500 miles), with cast iron. This road was to be 5.5 meters (18.04 feet) wide and to require about 3,000,000 tons of iron. The cost was to be 256 million francs.

One of the arguments in favor of this road was that the French blast furnaces were not operating at full capacity and could convert more iron ore into iron than they were then doing. This surplus iron made from the ore mined near the German border could be used to surface highways in the interior of France. In times of need, the iron surfacing blocks could be removed from the roadway and converted into other

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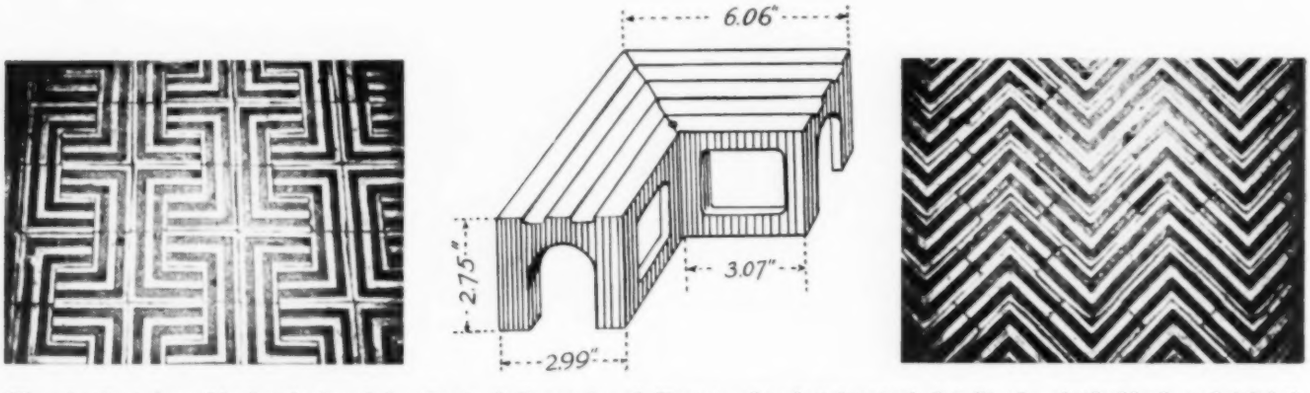

Fig. 4—Cast iron blocks designed by General Gascouin of France, showing (center) details of a single block and (right) and left) two methods of laying

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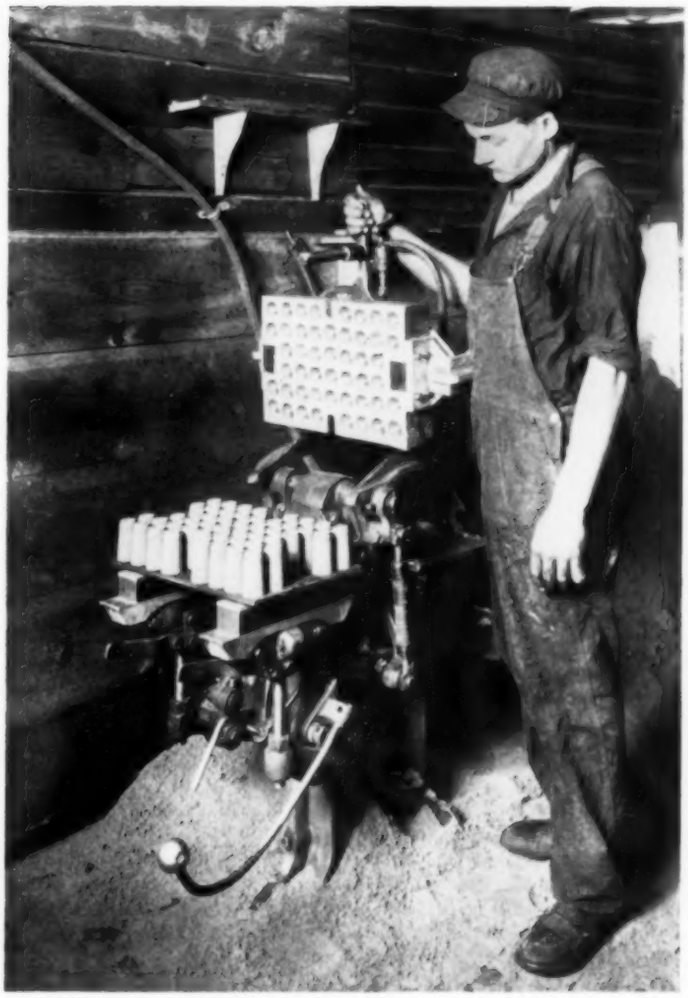

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(*Concluded from Page* 46)
more important commodities, and for a few years the concrete base alone could be used as a highway.

The soundness of this argument is not important. The important fact is that cast iron surfacing in France is considered so permanent that the metal can be considered as a reserve supply of cast iron available for any future use. As a justification for this conclusion, it is stated that some manhole covers have been in use in Paris for over 100 years and while the pavements surrounding them have been replaced many times, the cast iron covers are still in execellent condition.

Study Cast Block Designs

Several types of cast iron surfacing blocks now are undergoing experiments in Paris and several sections of city streets have been paved with these blocks. General Gascouin, who has been interested in cast iron roads for many years, has designed and tried out several types of surfacing blocks. The latest type is in the form of the letter L, 15.4 centimeters (6.06 inches) on each leg and 7 centimeters (2.76 inches) thick. These blocks are completely cored out on the under side to reduce the weight and a hole is cored in the top through which cement is poured to completely fill the space between the cement base and the casting. This type of surfacing block weighs 130 kilograms or 287 pounds per square meter of paving surface and can be laid in different designs to suit traffic conditions. Some of these blocks have been in use for over two years and are reported to show no wear.

The second type of surfacing block, made by the Societe des Hauts-Fourneaux de Saulnes and in use on some of the Paris streets, is quite similar to the tripedal system in use in England. The blocks are about 24 centimeters (9.45 inches) on a side, are laid on a concrete base, and are cemented together with asphalt mastic. Arrangement of the studs on the wearing surface differs somewhat from the English system, but otherwise the blocks are very much the same.

French paving authorities have given much attention to the arrangement of the studs and corrugations on the exposed surface of the iron paving blocks. Special designs for one-way streets and for steep hills are being investigated. Horse-drawn vehicles are common in some districts in Paris and a special arrangement of studs is proposed for these districts in order that the horses may have a firmer footing. French authorities are investigating the possibility of controlling automobile speeds by the proper arrangement of corrugations and waves in the paving surface. Other designs have been made for ease of cleaning and for artistic appearance.

Considerable attention also has been given to the wearing qualities of cast iron blocks of different designs, and the Societe des Hauts-Fourneaux de Saulnes has installed a test course on which various types of pavements are laid and worn down by the action of an iron wheel. The course is in the form of an annular ring, 9 meters (29.5 feet) outside diameter and 4 meters (13.12 feet) inside diameter. Sections of the various types of pavements to be tested are laid in this annular ring. In the center of the ring is a pivot point from which an arm extends over the paved surface. Wheels of various types are attached to this arm and a horse, hitched to the end of the arm beyond the pavement. drags the wheels over the paved surfaces. The standard test wheel is of cast iron, 1 meter (39.37 inches) in diameter and 10 centimeters (3.94 inches) wide where it comes in contact with the pavements. This wheel weighs 1500 kilograms (3307 pounds) and exerts a pressure of 150 kilograms per centimeter (2133 pounds per inch) of width which is the load specified by the French road code. Since the weight is not cushioned by springs or rubber and since the wheel always rolls in the same track around a curve, the wear on the pavement is severe.

In one test, a pavement of stone blocks was entirely worn out after 750 revolutions of the wheel around the course, but the cast iron blocks showed no wear after 30,000 revolutions. Although France has actually laid less cast iron pavement than England, the French authorities are giving this type of pavement careful consideration with special reference to the most efficient and economical design for each particular type of service.

Urge Use in America

In view of the fact that such satisfactory reports have been received on the use of cast iron for paving purposes, it would seem that some experimental sections of roads should be tested under the traffic and climatic conditions of this country. Cast iron block surfacing is used largely in cities where traffic conditions are most severe, but for general highway work the open-grid foundation type, surfaced with mastic or concrete, should be given consideration. In England the cast iron sections used in these pavements cost about $30 per ton. In some localities in the United States these sections could be manufactured at two-thirds of this cost. At Birmingham, Ala., for example, the price of pig iron is normally about $14 per ton and on a quantity production basis it might be possible to cast these blocks directly from the hot metal from the blast furnace or hot metal mixer.

Pig iron can be made at Duluth or other points on the Great Lakes for about $16 per gross ton. Allowing $4 per ton for casting the shapes required for paving purposes gives a cost of $20 per gross ton, or $18 per net ton. One net ton of cast iron surfacing blocks will cover about 8½ yards of pavement, making the cost of the paved surface $2.12 per square yard. Adding to this 50 cents for freight and delivery charges, 30 cents for the asphaltic filler, and 40 cents for labor, gives a total cost of $3.32 per square yard of paved surface. With brick surfacing in Minneapolis costing $2.50 per square yard, it is seen that the cast iron block surfacing will cost about one-third more than brick surfacing. If the claims made by the foreign manufacturers and highway engineers are correct, iron blocks are worth the difference in cost.

For the cast iron foundation type of pavement, in which the grids or plates weigh about 13 pounds per square foot, one ton of castings will cover 17 square yards of pavement. This gives a cost ready for the bitulithic or asphalt surfacing of about $1.50 per square yard, which is a little less than the cost of a concrete pavement before the asphalt surfacing has been applied. The durability of this type of pavement is not so definitely known since it has not been in use for as long a time as the cast iron block type. For general highway work, however, it seems to compete in cost at least with the pavements now in general use.

Bearings Code Authority Is Approved

The National Recovery administration has approved a code personnel of the Railway Brass Car & Locomotive Journal Bearings and Castings Manufacturing Industry as follows: W. H. Croft, president, Magnus Co. Inc., Chicago; J. B. Strauch, president, National Bearings & Metals Corp., St. Louis; C. W. Beugger, comptroller, National Bearings & Metals Corp., St. Louis; Benjamin I. Kaufmann, president, Edna Brass Mfg. Co., Cincinnati; and F. A. Croft, vice president, Magnus Co. Inc., Chicago.

Pig Iron Production Registers Gain

Production of foundry pig iron during the first half of 1934 totaled 691,687 tons as compared with 254,759 tons in the first half of 1933, according to a recent report of the American Iron and Steel institute. Production of malleable pig iron for the first half of 1934 was 505,504 tons as compared with 190,914 tons during the similar period in 1933.

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The Adventures of Bill

BY PAT DWYER

AMONG all the schemes proposed," said Bill the other night, "for extracting these United States from the slough of despond, I am surprised that more serious consideration was not accorded the statesmanlike proposition submitted by Dr. Moulton several months ago."

"What is this marvelous scheme?" I inquired, "And who, pray, is this Moses, this Pilgrim bearing this banner *Excelsior* showing us the way out of the well known slough and into the Promised Land?"

"Touching on the second part of the question, I never heard of the bird before, or since for that matter, but I read his views as set forth in a Chicago paper some time ago.

"He claimed government statistics show that there are 3,000,000 cats in the 30,000,000 homes in this country. It is also well established that one cat will consume as much milk as the average human being. Hence if the cat population was increased to 120,000,000 the consumption of milk would be increased forty-fold.

"Since a sufficient number of consumer cats can be acquired by refraining from drowning the normal crop of kittens for a few months, there should be no necessity of increasing taxes or enlarging the PWA to obtain the necessary cat inventory with which to start our cat recovery program. If the cat population was increased 4000 per cent, it would mean at least 1926 prices for milk and complete parity with industrial prices.

"With milk demand increased forty-fold there would be required 40 times more cow feed, barns, milk pails, motor trucks, clerks, pitchforks, etc., than at present. This would furnish an immediate stimulus to the building, tin can, steel producing industry, which in turn would stimulate activities at the tin and iron ore mines and steel works. This would cause a great increase in freight car loadings, which would cause the railroads to hire more men, buy more cars and locomotives and use more coal.

"More important even than these, the increased demand for cow feed would solve the farm surplus problem. Demand for farm hands to milk cows and to drive milk delivery wagons would solve the farm unemployment problem and help the President in tapering off the CWA in the country districts before the frost is on the pumpkin and the fodder's in the shock. Since the earnings of the railroads would increase as the cat population increased, there would be a great rise in the stock market. The combination of a rise in stocks and a rise in grain prices due to the enlarged demand for cow feed to come from the cat movement would unfreeze billions of dollars of collateral loans and would bring the reopening of many closed banks. The market for farm lands also would open up nicely under these new conditions and there would be a cessation of foreclosures on farms and the reopening of many small country banks. It should not be long before the farmers would be paying off their new loans from the Farm Credit Administration and the government then would be enabled to reduce the income taxes.

"Dr. Moulton, whose story I am repeating from memory goes further. He points out that the inevitable mortality of the cat population would be capitalized to create many new demands for capital and labor which would cure technocracy. There could be time payment, cat financing institutions to help those late in getting into the game and who are without surplus cat buying funds. This paper would be self liquidating and would create a great amount of paper which the banks would be glad to buy in order to acquiesce in the demands of Jesse Jones to expand credit. There would be created great financing companies to organize cat cemetery associations which would spend their money to see that these patriotic dead cats received respectable burial. These activities would help to revive marble quarries in Georgia, limestone quarries in Indiana and granite quarries in Vermont. Since each cat has nine lives, this corporation could incor-

The gent on the right would plow them under or drown them

porate for at least 999 years.

"Those who may wish particularly to commemorate the special service which our felines would contribute to humanity might like to build cat crypts with bronze gates and ornaments. This would help the copper, tin and foundry industries. Public spirited citizens might organize cat benefit associations which would employ many veterinarians to minister to cats that might fall ill from time to time. To keep householders informed on how to care for the tabbies a number of cat trade journals would be needed. This would aid unemployed newspaper men, editors, printers, press men, specialists, circulation and advertising solicitors.

"The cat radio hour would come along in due course and some enterprising Washington bureaucrat would organize a system of reporting on cat economics. In order to make this enterprise understood quickly and to rally the people, the first requisite would be a symbol. This should be a blue cat, which should hang in the front window of every home.

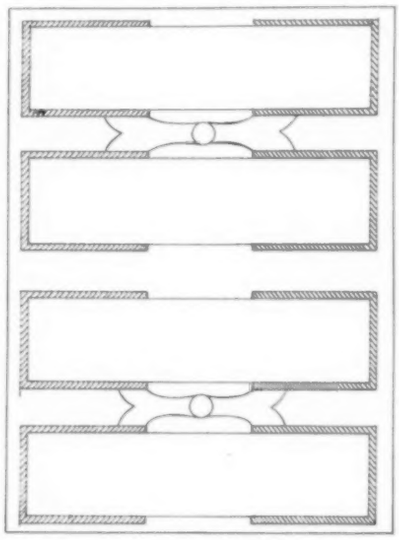
"However, some person would be sure to find fault with this program. Sooner or later there would be a great over production of cats, which would be accompanied no doubt by a great inflation in cat credits and cat stocks. Then a great deflation would ensue. Cats would come raining down from the skies and from under the beds. 'Dead cats would fill the air' Secretary Wallace would be called out of retirement to launch a cat killing program at $5 a head in order to balance production and get a parity between farm and city cat prices. General Johnson would come on the scene demanding that each cat drink more milk, but live a shorter life, to share the work with the unemployed cats. Householders would be required to sign codes of fair cat competition, and a bureaucracy of compliance officials would grow up.

"Finally the people would find that it took so much milk to feed the bureaucrats (sic) that there would not be enough to feed the recovery cats. Great numbers would decide to dispense with the cats, as well as the bureaucrats. The blue cats would come raining down out of the windows and after 4 or 5 years the country would be back to where it started, with 3,000,000 cats for 30,000,000 families and all would be resigned to go to work again."

"If you ask my opinion," I said, "I think the whole thing rather silly, all wind and soap bubbles, like a barber's cat. Cats are carnivorous animals and only lap up a small dose of milk occasionally when nothing else is available. Have you ever seen a foundry cat drinking milk?"

"Now that you bring the point to my attention," Bill admitted, "I never have seen a foundry cat drinking anything. For that matter I never remember seeing a foundry cat eating anything. How they live is one of the seven wonders of the world. However, your reference to the foundry reminds me of an inquiry I had recently from a man who forwarded a miniature beer barrel casting 2 x 3 inches, which he proposed making in a permanent mold. He wanted information on the proper metal for the mold and if aluminum can be poured successfully in a permanent mold, also where could he procure suitable metal for die casting purposes. The core was to be green sand.

"I wrote that aluminum is poured



Suggested arrangement for sand casting

extensively by the die casting and also by the gravity method in either cast iron or steel molds. Other alloys also are employed perhaps to a greater extent than aluminum and may be ordered in ingot form from manufacturers in nearly all the principal cities. However, the subject is so broad and presents so many ramifications that further comment is justified.

"In this particular instance where the casting is comparatively plain and simple in construction, and designed merely to serve an ornamental purpose, the factors of strength and reliability under operating conditions are of no importance. Hence the problem resolves itself into one of economics, that is to use a metal which costs less than any other. Since the range extends through alloys with a tin base, alloys with a zinc base, alloys with a lead base and alloys with an aluminum base, a selection may be made based on the cost of the ingot. In this connection also it must be remembered that the life of the mold to a considerable extent depends on the temperature of the metal poured into it. With modern heat treated steel, the life of a mold in which zinc base alloys are poured is practically indefinite. With aluminum alloys the life is limited by the development of check cracks. For a comprehensive description of this and practically every other related feature I suggested a study of *Die Casting Practice* by Marc Stern which may be purchased through THE FOUNDRY.

"Several alternative methods are available for making castings similar to the sample submitted. Obviously the method adopted will depend on the size of the present or anticipated orders. If ordered in sufficient volume, the best method would be to submit the problem to a manufacturer of die mold or permanent mold equipment. Any of these firms would supply the necessary equipment at probably a lower cost than would be entailed by long and costly experiment on the part of the inquirer.

"If he decides to make the permanent mold himself, the anticipated volume of orders becomes the deciding factor on whether to make a single mold, or, a multiple mold in which four or possibly six castings may be poured simultaneously. In either instance the mold will be split vertically instead of horizontally as in ordinary sand practice. For a single casting the mold will include three parts, a bottom plate or base and two side members hinged at one side and provided with a suitable clamp or lock on the opposite side. The base will be recessed for a flange on the bottom end of the core. This recess, tapered on the sides and extending under the side members of the mold will center the core accurately and also prevent it from lifting when the mold is filled with metal. The casting will be gated at the bottom and one or two small holes in the top or closed end, will permit the vent to escape. The green sand core, of course, is vented through a hole in the bottom plate. The green sand core must be sprayed lightly with thin molasses water or other core binder to prevent the surface from crumbling in the hot mold before the metal enters. A comprehensive article on design, construction and operation of permanent molds for aluminum castings appeared in THE FOUNDRY, Nov. 15, 1929.

"The casting could be made by the slush mold process in which no core is required. A hinged metal mold is mounted on trunnions with the open side on top. The mold is filled with molten metal and the metal is allowed to cool until it forms a shell of the desired thickness inside the mold. Then the mold is inverted and the surplus metal is spilled out. The mold is opened, the casting removed and the process repeated indefinitely.

(*Concluded on Page* 64)

Uses Plaster for Foundry Patterns

(*Continued from page* 13)

military and naval forces of the United States. A replica 3 x 5 feet of the tablet shown in Fig. 2 meets the eye of all visitors to the W. S. Tyler office. Artistically the design seems to present a particularly happy inspiration, names of the men arranged with military precision in three orderly columns, fighting scenes on land and sea and in the air depicted in low relief in the four corners, the Liberty Bell, symbol of American independence flanked on either side by the national colors and surmounted by the great war eagle in characteristic pose emblematic of a free people who believe that government of the people, by the people and for the people should not be allowed to perish from the earth.

Pattern in Sections

To facilitate production in the foundry, the pattern for this tablet was made in five sections, the eagle, flags and bell, upper and lower relief sections, and the central part containing the inscription and roll of names. With this arrangement the central section might be shortened or extended to accommodate a greater or lesser number of names. Also if a defect appeared in any of the sections, the part might be recast instead of remaking the entire tablet. With the various parts containing the same composition of metal, with the joints accurately matched and with surface chased and polished, the finished tablet so far as outward appearance is concerned is a one piece casting.

Method adopted in the construction of a tablet pattern hinges on many factors, including size, design of border and character of inscription or ornamental features. In some instances wood may be used, but in the majority of instances plaster is the most satisfactory material. As with other castings where a considerable number are required, a metal pattern is prepared from the original master pattern of wood or plaster. Usually a tablet is set up as an independent unit, therefore the shrinkage factor may be ignored. However, where a number of duplicate castings are designed to be set up in united form, or, where the casting has to fit into a definite space in a general assembly, double shrinkage allowance must be provided on the original pattern.

Ingenuity, knowledge and skill of the patternmaker will guide him in the best method to select in any given instance. Several typical methods are presented in the following description, but—as with railroad schedules—under press of circumstances they may be changed or adapted.

Wood may be used for a small comparatively plain tablet. The main objection to wood—and this objection of course increases in direct ratio to the size of the pattern—is that the dampness of the sand causes the pattern to warp. Two methods may be employed to overcome this tendency. In the first, a number of braces or stiffeners are screwed to the back of the thin pattern. These braces are accommodated in slots in the rollover board, or, alternatively in grooves formed in the sand face of a false cope. After the mold has been rolled over and the proper cope lifted off, the depressions left by the braces are filled with sand.

In the second method the thin pattern is backed solidly by a board 1 to 2 inches in thickness. Assuming that the combined thickness of pattern and board is 2 inches and that the casting is to be ¼-inch thick, the desired result is secured by placing wood slabs 1¾-inch thick between the drag and the rollover board as shown at *AA*, Fig. 9. Instead of the loose slabs, the original board may be extended all around the pattern where the pattern will appear as if mounted on a matchplate.

When the drag is rolled over the rollover board is removed, but the pattern board with extensions is left in position. Assuming that the back of the tablet is to be flat, the cope is rammed on the flat face presented. The cope then is lifted off and the pattern board with extensions removed. Manifestly, when the cope is placed on the drag again the upper and lower faces of the mold will be the required ¼-inch apart, giving the necessary metal thickness.

A slightly different procedure is followed in the event that the face of the pattern presents an uneven contour. Approximately the same contour must be reproduced on the cope face to maintain a uniform thickness of metal in the casting. In this instance ¼-inch strips (or any other thickness corresponding to the desired thickness of the casting) are placed between the rollover board and the drag as shown at the top in Fig. 4. After the drag is rolled over the rollover board, pattern and strips are removed. Parting dust is sprinkled over the entire drag face. The cope is set in place, rammed and lifted off and finished.

Where a tablet casting at the rim shows a section similar or corresponding in a general way to that illustrated in Fig. 7, the usual method of providing for the thickness of the vertical wall is to place wood strips of the required thickness in the drag impression of the mold as shown in Fig. 6. In a second method sometimes practiced the molder provides the necessary thickness on the side walls by shaving away a thickness of sand as shown in Fig. 5 where *M* is a straightedge and *N* represents the thickness of sand corresponding to the required thickness of metal.

In either of the foregoing instances the first drag merely is a convenience to secure the cope impression. After the cope has been removed, the first drag is shaken out and another one prepared. In the second instance the thickness strips are omitted from between the drag and the rollover board.

In this connection it is interesting to note that a variation of the foregoing method is practiced occasionally in stove, hollow ware and other foundries for making metal patterns. A drag mold is made in the usual manner from a solid *block* pattern. After the drag is rolled over this block pattern is removed and the face of the pattern impression is lined with clay rolled to the thickness of the desired pattern. Sheet pattern wax cut in strips and softened in hot water may be used for the same purpose. The cope is rammed against this coating, lifted off and finished. The original drag is shaken out and a new drag is prepared. Manifestly when cope and drag are assembled the mold cavity will correspond to the thickness of the clay or the wax.

Handling Plaster Molds

Since plaster sets quickly it becomes necessary, particularly on large tablet patterns to prepare several sections separately and then assemble them. In some instances the entire original model is formed in clay, but in the majority of instances, plaster is manipulated to form either the entire object, or a general approximation on which the finishing clay is superimposed. Strickles or sweeps mounted on suitable guides are employed to shape the soft plastic material as in sand or loam molding practice. Thin sheet steel templets cut to the desired contour are attached to the lower or cutting edges of the sweeps.

Consider for example the tablet shown in Fig. 1, a flat plate enclosed in a picture frame molding . A rectangular wood frame 2 inches high and conforming to the dimensions of the plate was placed upon a flat table and filled with plaster. The upper face was struck off flush and true with a straightedge. The molding for the sides and ends was prepared by the method illustrated in Fig. 8. The two guide strips *P* and *Q* were mounted on a flat table or bench. Plaster in a plastic condition was spread between them and shaped to the desired contour by drawing the sweep or strickle *S* over the surface several times. After the plaster had dried the ends of the molding strips were mitered with a saw and the four pieces were assembled around the flat slab. The ornamental features in

(*Continued on page* 54)

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Tests in a malleable foundry showed conclusively that the metal could be held almost three times as long in a covered, insulated ladle as in an open ladle, with a corresponding drop in temperature. The malleable foundry whose installation is shown here, stepped up from a 500 pound open to a 1200 pound covered ladle.

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(*Concluded from page* 52)

relief were modeled in clay. Since this merely was the pattern for the pattern, the letters and figures were not attached at this stage of production.

A rectangular wood frame 5 inches deep and corresponding to a drag was placed in position around the model and filled with liquid plaster after the face of the model had been painted with stearic acid dissolved in kerosene oil. Many other substances are employed as parting materials in plaster practice, including soap suds, paraffine wax and kerosene oil, beeswax and turpentine, lard, castor oil, crude oil and vaseline. Unless a parting medium is employed, plaster will stick to practically every material except modeling clay or glass.

Mixed to Formula

The grade of plaster is known as dental plaster, sold in bulk at a few cents per pound, is ground exceedingly fine and takes a minute impression. Individual pattern and model makers have private formulas for additions which increase the strength or improve the appearance of the material in finished form. Individual preference and local conditions also govern in the selection and distribution of reinforcing materials in any given object. Fiber, the material from which ropes are made, is used extensively. Sacking and wire mesh are incorporated in plaster creations. Sections of metal rods or pipes in various sizes are employed. In some instances the reinforcing agent is placed in the mold and the plaster poured around it, or, in plastic form thrown or daubed on by hand. However, usually the reinforcing material is pressed into the semiliquid mass with the fingers.

After the plaster drag solidified it was rolled over. The combination plaster and clay model was removed. The mold cavity in the drag was cleaned, washed, touched up where necessary and painted with a parting compound. This mold then was filled with plaster to form the actual or working pattern for the foundry, 1½ or 2 inches in thickness. The plaster pattern was removed from the plaster mold and retouched wherever necessary. The letters and figures were arranged in proper position and attached with shellac. The entire pattern was given a coat of shellac and then mounted face up on a large flat slab or rollover board.

The mold was made in the manner described previously and illustrated in Figs. 4 and 6. At one time an impression prevailed—prevails yet to some extent—that ornamental bronze castings could be produced in nothing but French sand. Experience has shown that excellent native sand is available in many sections of the country. In the present instance all the castings shown in the accompanying illustrations were made in sand from the Zanesville, O., district. Before shipment it is graded carefully by the producer to insure uniformity. In the foundry the facing sand is mulled before it is sifted over the pattern through a 16-mesh sieve.

After the molder removes the pattern from the second or true drag, he shakes plumbago through a bag over the face of the mold. The pattern then is returned to place and rapped down after the manner practiced in stove shops and known as *printing back*. The pattern then is removed for the last time and the surface of the mold is sprayed with molasses water, or with water containing a small amount of any water soluble core binder.

Any one of several methods and fuels may be employed for drying the face of the mold, depending to some extent on the size and shape of the mold and on whether it is in a wood or iron flask. An iron or steel flask may be handled with a certain degree of impunity, but an experienced foundryman hesitates to lift a large wood drag and place it in an oven. Highly satisfactory results are secured by building a charcoal fire on a thin steel plate mounted immediately above the face of the mold.

This is the first of five articles dealing with the use of plaster as a pattern material for tablets and other castings. The second article will appear in an early issue.

THE EDITORS

Interest in A. F. A. Convention Gains

(*Concluded from page* 15)

of Sands," by R. C. Hill, Cornell university, Ithaca, N. Y.

"Analysis of Sea Coal as Applied to Black Sand," by R. E. Aptekar, Ypsilanti, Mich.

"Effect of Silt on Bending Strength of Sands," by Dr. H. Ries, Cornell university, Ithaca, N. Y.

10:00 a. m.—Joint A. F. A. and A. S. T. M. meeting on Cast Iron Tests and Specifications.

"Test Bars," by J. T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala.

"Investigation of Test Bars," by C. M. Saeger Jr., U. S. bureau of standards, Washington.

"Horizontally Poured Test Bars," by Garnet Phillips, Frank Foundries, Moline, Ill.

"Fatigue Tests of High-Strength Cast Irons," by H. F. Moore and J. J. Picco, University of Illinois, Urbana, Ill.

10:00 a. m.—Refractories.

12:30 p. m.—Special Visit to Plant of Bethlehem Steel Co., Bethlehem, Pa. Under Auspices of Philadelphia Foundrymen's association. Trip by Train.

Chicago Section Announces Lecture Course

Fundamentals of ferrous foundry practice and casting application will be covered in a lecture course to be held in Chicago this fall and winter under the auspices of the Chicago section of the American Foundrymen's association. A series of 12 lectures will be presented by outstanding authorities on important subjects relating to the production and use of ferrous castings.

Lectures will be given at Lewis institute, 1951 West Madison street, Chicago. A nominal charge for the 12 lectures of $1 will be made for members of the Chicago section of the American Foundrymen's association and $2 for nonmembers. L. J. Wise, Chicago Malleable Castings Co., is chairman of the committee in charge of the course.

The tentative schedule of subjects and dates of the lectures follows:

Oct. 11: "Iron Ore to Foundry Pig Iron" by E. L. Clair, manager, Toledo plant, Interlake Iron Corp.

Oct. 18: "Cupola Melting Practice" by F. K. Vial, Griffin Wheel Co., Chicago.

Nov. 8: "Air Furnace and Duplex Melting Practice" by W. R. Bean, vice president, Whiting Corp., Harvey, Ill.

Nov. 15: "Open Hearth and Electric Furnace Melting Practice" by C. E. Sims, metallurgist, American Steel Foundries, East Chicago, Ind.

Nov. 22: "Molding Practice" by Pat Dwyer, engineering editor, THE FOUNDRY.

Dec. 13: "Pattern Making" by Vaughan Reid, president, City Pattern Works, Detroit, and "Core Making" by T. S. Richardson, foundry department, Crane Co., Chicago.

Dec. 20: "Metallurgy and Heat Treatment in the Manufacture of Iron Castings" by H. Bornstein, Deere & Co., Moline, Ill.

Jan. 10: "Metallurgy and Heat Treatment in the Manufacture of Malleable Iron Castings" by J. H. Lansing, general manager, Grand Rapids Malleable Works, Grand Rapids, Mich.

Jan. 17: "Metallurgy and Heat Treatment in the Manufacture of Steel Castings" by Maj. R. A. Bull, Chicago, consultant on steel castings.

Jan. 24: "Testing Methods and Specifications" by Prof. R. C. Huntley, Armour Institute of Technology.

Jan. 31: "Selection, Properties and Uses of Ferrous Castings" by Harold F. Allen, engineer, Link Belt Co., Chicago.

Code of fair competition for the aluminum industry was approved by the NRA administrator on June 26 and became effective on July 11.

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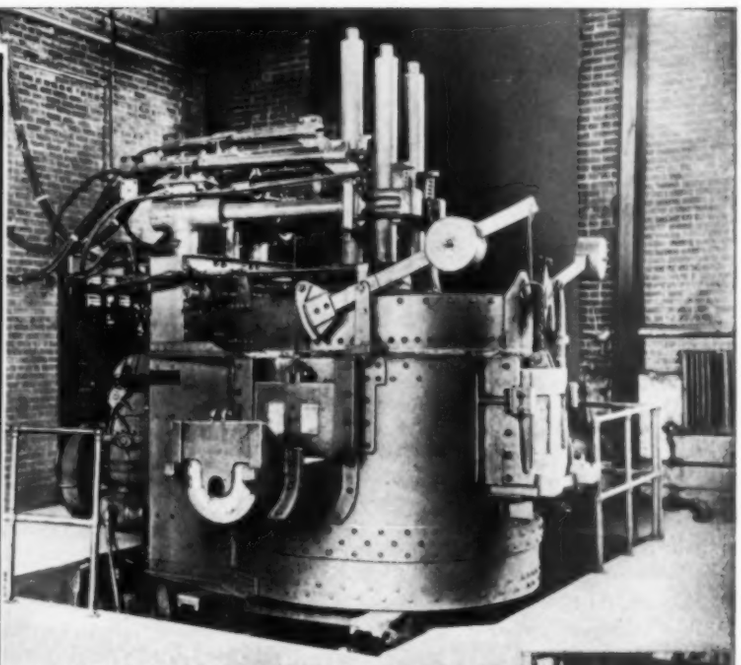

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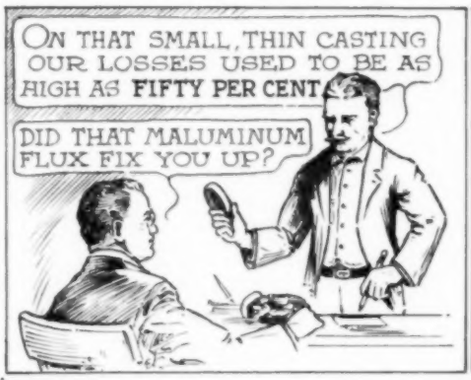

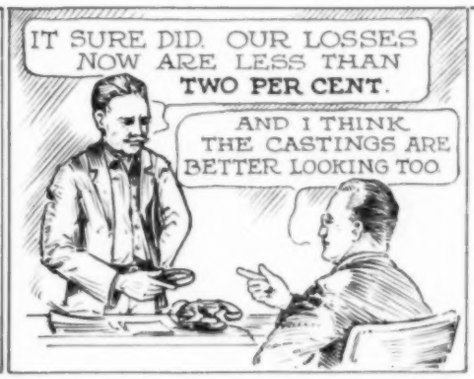

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Heat Treatment of Cast Iron

(*Continued from page* 18)

square inch tensile and appreciable ductility, considerable attention has been given production of *super* cast irons or *semi* malleables. Any method used on low carbon iron that will bring about very fine graphite formation, with freedom from flakes of appreciable size and an unusually strong matrix is suitable.

Piwowarsky (*Foundry Trade Journal*, July 7-14, 1927) prepared superheated mottled base irons analyzing 2.48 per cent carbon, 2.06 per cent silicon, 2.80 per cent nickel and 0.50 per cent chromium. These were annealed carefully. Tensile strengths of 106,000 pounds per square inch maximum were attained, with elongation of 4 per cent.

Morken (*Transactions*, ASST—1933) has described a treatment applied to superheated white iron analyzing 2.40 carbon, 1.65 silicon, 0.25 manganese, sulphur and phosphorous low, as follows: Anneal at 1750 degrees Fahr. for 3 hours; cool in air to 1400 degrees Fahr.; oil quench; draw at 1350 degrees Fahr. 1 hour. Properties of the iron after treatment are as follows:

Tensile 100,000 to 125,000 pounds per square inch.

Yield point 85,000 pounds per square inch minimum.

Elongation 3 per cent in 2-inch gage, minimum (7 per cent maximum).

Charpy (impact) 5 to 7 foot pounds.

Modulus of elasticity (tension) about 30 x 10^6.

Brinell hardness 225-275.

It is obvious that a considerable range of properties can be attained by annealing white and mottled irons followed by various combinations of quenches and draws.

The nitriding or nitrogen case hardening process is used to produce an intensely hard case on iron and steel parts. This case, when properly formed, is exceedingly wear resistant and possesses some corrosion resistance properties.

In the process iron or steel of suitable composition is exposed to anhydrous ammonia gas, usually at about 950 degrees Fahr. for periods generally from 72 to 90 hours. Intensely hard nitrides are formed at and adjacent to the surfaces. The depth of penetration depends on time, temperature and composition of material. The so-called 1000 brinell surface case rather rapidly tapers off in hardness the maximum range being within a depth of 0.010-inch from the outside.

While ordinary cast iron can be nitrided, the case is thin, not very hard and decomposes readily at elevated temperatures, iron nitride apparently being the nitride formed. Most of the commercial nitriding irons and steels contain aluminum. Aluminum combines rather readily with nitrogen in this process, and

(*Concluded on page* 59)

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ADVERTISING PAGES REMOVED

(*Concluded from page* 56)

helps in the formation of a good hard and stable case. Other elements which form nitrides rather readily are chromium, vanadium, molybdenum, manganese and tungsten.

A typical nitriding cast iron contains the following: Total carbon 2.50 to 2.75 per cent; silicon 2.30 to 2.60 per cent; manganese 0.60 to 0.80 per cent; sulphur 0.08 per cent maximum; phosphorus 0.10 per cent; chromium 1.50 to 1.80 per cent; aluminum 1.50 to 1.80 per cent.

It will be recognized that this composition has air hardening properties. Before rough machining, the iron is subjected to an anneal at about 1750 degrees Fahr. After rough machining the parts are quenched in oil from 1600 degrees Fahr. and drawn at 1100 degrees Fahr. After finish machining the castings are nitrided. Nitriding generally produces some slight growth for which allowance should be made. Other than light finish, grinding should be avoided to prevent removal of the hardest part of the case. When properly nitrided the case does not spall or break off readily. Base material of the sort described has good strength and rigidity.

Tinning Prevents Nitriding

While nitriding machined surfaces is more usual, some case formation can be effected on carefully sand-blasted surfaces. If it is desired that only parts of a casting be provided with a hard case the remainder is tinned or otherwise suitably treated to prevent nitride formation.

Work has been done with chrome-vanadium irons and nickel has been added to regular nitriding irons. Progress in this field is under way and improvements will be attained. Nitrided cast iron has been used in machine tool parts, in cylinder liners and the like where high resistance to wear and abrasion is desired. The most serious drawback to the method is the high cost of nitriding.

The term annealing usually is employed to denote heating to temperatures above the Ac_1 point and slow cooling from that temperature. It also is possible to anneal gray irons by holding for long periods at temperatures below the critical range—for example annealing at 1250-1300 degrees Fahr. As previously mentioned complete annealing of gray iron produces a soft structure composed of ferrite and graphite. Among the more illuminating of the early researches in this field are those of G. S. Evans, Piwowarsky, Hurst, Schuz, Harper and MacPherran, Donaldson, Potter, Beeny and others.

For ordinary irons heating to 1500 to 1600 degrees Fahr., allowing just enough time for heat penetration, and cooling slowly to 1200 degrees Fahr. or below, will produce almost complete annealing. However, such annealing usually is accompanied by loss of considerable tensile strength. Slower annealing at 1350 to 1450 degrees Fahr. will not result in quite so much strength drop but about the same final hardness, 120 to 130 brinell, is attained. Heating for appreciable periods at 1250 to 1350 degrees Fahr. will produce even less weakening, usually not much over 10 per cent.

Some of the results of Harper and MacPherran are reproduced in Figs. 22, 23 and 24. Donaldson's results, testing bars at elevated temperatures both as cast and after annealing are shown in Fig. 28.

Low silicon, low carbon irons anneal less readily than higher silicon, higher carbon metals. The addition of alloys, particularly carbide formers, such as chromium raises the necessary annealing temperature quite materially. Irons with chill spots also often require high temperatures for anneal, temperatures up to 1700 to 1800 degrees Fahr. not being unusual. No hard and fast rules can be drawn to cover all cases. Annealed alloy irons usually are harder than annealed plain irons.

Since annealing of gray irons is accompanied by reduction in strength, hardness and wear resistance with no appreciable compensation in ductility, as malleable irons gain ductility, the usual object of annealing is economy in machining. Thoroughly annealed gray iron probably is the most readily machined of ferrous metals.

Mention might be made of annealing of permanent mold castings, some types of which are almost unmachinable as cast.

Summarizes Treatment Data

In conclusion, heat treatments applied to cast irons are relatively new developments. They offer opportunities for improvements in quality and certain economies. Different treatments are used for different purposes. These may be summarized as follows:

1.—Quick aging to remove internal stresses; usual temperature 900 degrees Fahr.

2.—Quenching and drawing to increase hardness and strength; usual oil quench is from 1500 to 1550 degrees Fahr. followed by draw to 700 degrees Fahr. or above.

3.—Production of high strength semimalleable by anneal, quench and draw.

4.—Production of an extremely hard case by nitriding after suitable heat treatment and machining operations.

5.—Annealing to soften for increase in machinability; usual range is from 1350 to 1500 degrees Fahr.

Owing to the many combinations of treatments possible this article can cover only the more typical. Reference to the abstracts in the accompanying table will prove valuable to those interested in further details. Choice of a good base iron, close attention to the accepted practices common to all heat treating operations, and a little experimentation are advocated.

This is the second and concluding article by Mr. Bolton on the heat treatment of cast iron. The first section appeared in the August issue.

The Editors

Book Review

The Ultimate Consumer, edited by J. G. Brainerd, assistant professor, University of Pennsylvania, Philadelphia, 230 pages 6¼ x 9¼, published by the American Academy of Political and Social Science and supplied by THE FOUNDRY, Cleveland, paper $2.00, or cloth $2.50 plus 15 cents postage, and in Europe by the Penton Publishing Co. Ltd., Caxton House, Westminster, London.

This symposium which constitutes the May issue of *The Annals* of the society, embraces 22 separate papers by a distinguished list of professors and those identified with voluntary consumer organizations and the Consumers Advisory board under NRA. It deals with the problem of the consumer who, according to Dr. Robert S. Lynd of the Consumers Advisory board, only in recent decades has risen to the status of a social problem. Dr. Lynd assails lures and snares of the manufacturer which add to the buyer's perplexity. He describes "deliberate obsolescence as an invention of the devil to outmode his (the consumer's) bath room, furniture, automobile or clothing by artificially enlisting social opprobrium before the article in question is worn out."

Price control under NRA is severely attacked by several outstanding professors of Columbia, university of Chicago and other educational institutions.

Of particular interest to industry is the chapter by Frederick J. Schlink, Consumers Research Inc., Washington, N. J., who outlines what the government should do for the consumer. He assails established bureaus in such terms as "The Bureau of Mines has a record, worse perhaps than that of any other government bureau, for not operating mainly in the public interest." State regulatory bodies manned by adequate, publicly paid staffs are recommended.

A chapter by P. G. Agnew, American Standards association, New York, recommends quality control in the buying and selling of commodities. Grade marking in accordance with specifications coupled with certifying plans and agencies are presented for consideration.

The publication is recommended for those interested in the study of the trend in academic thought so strongly emphasized in many phases of the "New Deal."

Nonferrous Foundry Cost System

(*Concluded from Page* 19)

of the best 6 consecutive months production after Jan. 1, 1924, then the *normal* volume of production shall be increased by the ratio of increase in plant facilities. Such ratio of increase shall be determined by the percentage of increase in plant investment. Likewise if any facilities in use during the period of the best 6 consecutive months after Jan. 1, 1924, have been sold or otherwise disposed of then the *normal* volume of production shall be decreased by the ratio of decrease in plant investment.

Having determined the percentage as above then that percentage of fixed overhead must be absorbed in the various departments. Items 21 to 25 above are perfectly distributed to departments on basis of floor space in each department, item 26 on basis of value of equipment installed and items 27 to 29 on basis of total payroll dollars or total labor man hours in each department. if individual distribution is not desired in any plant it is permissible to distribute the total *fixed overhead* (total of items 21 to 29 inclusive adjusted for current volume of business) to the departments on basis of total payroll dollars or total labor man hours in each department.

III. *Operating Overhead.*

The entire operating overhead must be distributed to and absorbed in the various departments.

31. General plant labor.
32. Plant supervision and plant office help.
33. Fuel and power, supplies and tools in boiler and engine room.
34. General Supplies.
35. Workmen's compensation insurance.
36. Loss on product scrapped, including returns from customers. (Not less than 5 per cent.)
37. Laboratory.

The total operating overhead is distributed on the basis of total payroll dollars or total labor man hours in each department.

IV. *Metal.*

Metal cost equals initial metal cost per pound plus metal expense per pound times weight of casting plus per cent of shrinkage.

41. Raw metals, purchased scrap, and alloys including freight and cartage. All at current market price for grade of metal used.
42. Metal Expense. Unloading, sorting and storing labor. Sampling inspection and analysis expenses on incoming metals. Total metal expense 42 for a period of one year divided by pounds of metal gives average metal expense per pound.
43. Shrinkage (based on type of metal used, etc., not less than 5 per cent of metal value 41).

V. *Melting*

Melting cost per pound of metal equals total of 51 plus 52 divided by pounds of metal used under IV.

51. All labor in the melting department. Handling metals and scrap, making up charges, melting repairing furnaces, metallurgists and chemists time spent on metals.
52. Burden.—All other items chargeable to the melting department.
    (a) Melting fuel including freight and cartage and including power for electric melting.
    (b) Supplies such as fluxes, crucibles, fire bricks, fire clay, and tools such as crucible tongs, shanks, shovels, scoops, etc.
    (c) Costs of analyses and tests made on metals.
    (d) Share of operating overhead (based on labor hours or payroll dollars).
    (e) Share of fixed overhead (based on labor hours or payroll dollars).

VI. *Molding.*

Molding cost equals direct labor plus burden plus direct materials.

61. Direct labor such as molders,, apprentices, molders helpers, and any other labor which can be directly charged to individual jobs such as skin drying, finishing, core setting, etc.
62. Burden—All other items except direct materials chargeable to molding department. Burden shall be proportioned against each job on basis of either total direct molding labor cost in dollars or direct molding labor total in man hours.
    (a) All labor not directly chargeable to individual jobs such as —preparing molding sand, mixing facing; transporting sand, castings, patterns, flasks, boards, supplies, etc.; repairing equipment in the department; foreman and clerks, repairing patterns not chargeable to customer.
    (b) Supplies and tools such as molding sand, including freight and cartage, facing sea coal, parting, plumbago, shovels, riddles, brushes, reamers, clamps, gaggers, chaplets, nails, air hose and fittings, etc. Pattern and flask repair parts and repair parts for equipment.
    (c) Fuel and power.
    (d) Share of operating overhead (based on direct labor (61) pjlus indirect labor (62a)

(*Continued on Page* 62)

Table I

Suggested Form for Making Estimate Of Cost of Nonferrous Casting

No.....

Customer..... Date .....

Address..... F.O.B..... Terms.....

Quantity..... Delivery .....

Part Name..... Drawing No..... Metal No.....

Type or Size..... Kind of Pattern..... Wgt. per casting.....

Mold Size..... Castings per Mold..... Wgt. Casting per Mold .....

Molds per day..... Gross Wgt. Metal per Mold..... Gross Wgt. Metal per day.....

Metal Specifications:

Copper	Zinc	Aluminum
Tin	Antimony	
Lead	Phosphorus	Impurities

Metal Costs per lb.

	%	@	Amount
Copper			
Tin			
Lead			
Zinc			
Alum.			
Formula total per lb.			
Metal Expense per lb.			
Total			
Shrinkage.....	%		
Total Cost Metal per lb.			

Material Costs on Job— Amount

Total wgt. of metal..... @ ..... per lb.
Patterns, flasks, plates, etc.
Core boxes, driers, rods, etc.
Cutters, band saws, tools, etc. for cleaning
Tools, dies, wheels, racks, etc. for finishing
Gauges, testing fixtures, cartons, etc. for inspection and shipping

Production Costs on Job—	Hours	Rate
Molding labor		
Molding burden		
Coremaking labor		
Coremaking burden*		
Cleaning labor		
Cleaning burden		
Finishing labor		
Finishing burden		
Inspection and shipping labor		
Inspection and shipping burden		
Delivery Expense		
Total Job Cost		

Scrap.....% of Job Cost

Cost of doing business.....% of Job Cost

Profit .....% of Job Cost

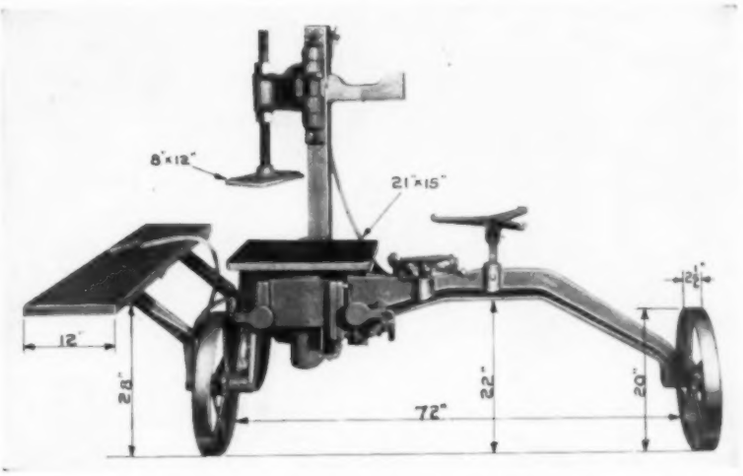
Price per piece ..... Price per lb.....

REMARKS:

Estimated by: .....

CHECK THESE POINTS!

—then you will choose JOHNSTON & JENNINGS IMPROVED Portable type Jolt-squeeze Machines



1 PROFITABLE INVESTMENT, low initial cost, increased production, more uniform castings.

2 SCIENTIFIC OPERATION, straddles the sand heap, knee valve jolt, poppet valve squeeze, pressure and jolt control valves regulate density of molds.

3 SIMPLE RIGID CONSTRUCTION. Anyone can dismantle or assemble complete machine in very little time.

4 DEPENDABLE CONSULTATION. More than twenty years of experience stands back of every J&J machine. Trained engineers are at your service.

Send for latest information on complete line.

THE JOHNSTON & JENNINGS COMPANY

Addison Road & N. Y. C. Tracks **Cleveland, Ohio**

A new and better Tumbling Method

New IDEAL Side-Loading Star Return Barrel

Reason No. 5

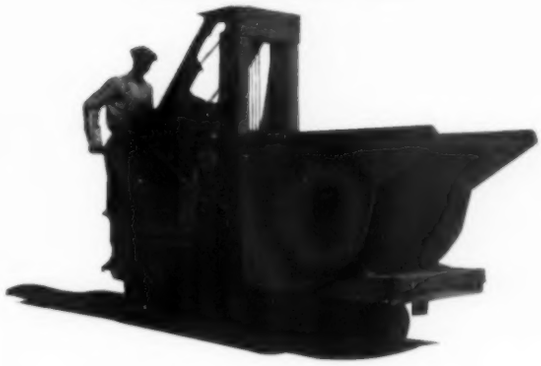
With stars in the two end sections, the work is loaded to the proper height in the middle or tumbling section. Throwing on power brings stars automatically into tumbling compartment.

Castings do not rub each other. The stars do the work. Result—cleaner, sharper edges on castings.

If you want at once the five other reasons why this system cuts tumbling costs, improves finish, write us.

N. Ransohoff, Inc.
West 71st St. at Millcreek, Carthage, Cincinnati, O.

ROURA
DUMPING HOPPERS



For the quick and economical movement of sand, clay, coal, coke, the transportation of castings and many other uses around the foundry, Roura End Dumping Hoppers are just the thing. Heavily constructed to stand abuse. Practical in every way; standard size for use with all industrial power lift trucks.

ROURA IRON WORKS
1401 Woodland Ave., Detroit, Mich.

(*Continued from page 60*)

either man hours or payroll dollars.)

(e) Share of fixed overhead (based on direct labor (61) plus indirect labor (62a) either man hours or payroll dollars.

63. Direct materials chargeable to individual jobs such as special flasks, matchplates, etc.

VII. *Core Making.*

Cost of cores equal direct labor plus burden plus direct materiads.

71. Direct labor such as coremakers apprentices, coremakers helpers, and any other labor which can be charged directly to individual jobs such as venting, blacking, pasting assembling, filing, rubbing, coating, gaging, etc.

72. Burden—All other items except direct materials chargable to the coremaking department. Burden shall be apportioned against each job on basis of either total direct core labor in dollars or direct core labor in man hours.

(a) All labor not directly chargeable to individual jobs such as preparing core sand, mixing, tending core ovens, transporting core sand, core boxes, repairing core boxes not chargeable to customer, repairing equipment, foremen and clerks.

(b) Supplies and tools such as core sand including freight and cartage, binders, core compounds, core oil, shovels, riddles, brushes, rammers, core plates, core wire, core rods, nails, core wax, etc., core box repair parts and repair parts for equipment.

(c) Fuel and power.

(d) Share of operating overhead based on direct labor 71 plus indirect labor 72 (a) either man hours or payroll dollars).

(e) Share of fixed overhead (based on direct labor 71 plus indirect labor 72 (a) either man hours or payroll dollars).

73. Direct materials chargeable to individual jobs such as special core rods, boxes, driers, etc.

VIII. *Cleaning, Trimming, Rough Grinding and Sandblasting department.*

Cost per job in this department equals direct labor plus burden plus direct materials.

81. Direct labor which can be charged directly to individual jobs such as for cutting off gates and risers, tumbling, sandblasting, pickling, removing cores, grinding, filing.

82. Burden—All other items except direct materials chargeable to this department. Burden shall be apportioned against each job on basis of either total direct labor cost in dollars or direct labor total man hours.

(a) All labor not directly chargeable to individual jobs such as those indicated under direct labor and repairing equipment, clean up labor, foremen and clerks, transportation of castings and scrap.

(b) Supplies and tools such as sandblast, steel shot, grinding wheels, band saws, hack saws, files, pickling acids, equipment repair parts, etc.

(c) Fuel and power.

(d) Share of operating overhead (based on direct labor 81 plus indirect labor 82 (a) either man hours or payroll dollars).

(e) Share or fixed overhead (based on direct labor 81 plus indirect labor 82 (a) either man hours or payroll dollars).

83. Direct materials chargeable to individual jobs such as special cutters, band saws, tools, wire brushes, cut off wheels, trimming dies, etc.

IX. *Machining, Polishing and Finishing Department.*

Cost per job in this department equals direct labor plus burden plus direct materials.

91. Direct labor which can be charged directly to individual jobs such as drilling, tapping, turning, boring, grinding, polishing, buffing, pickling, electric cleaning, plating, coloring, etc.

92. Burden—All other items except direct materials chargeable to this department. Burden shall be proportioned against each job on basis of either direct labor cost in dollars or direct labor total in man hours.

(a) All labor not directly chargeable to individual jobs such as those indicated under direct labor and also repairing equipment, clean up labor, transportation of castings, foremen, clerks, etc.

(b) Supplies and tools such as tool bits, drills, taps, reamers, polishing grit, wheels, and compounds, cleaning compounds, acids, plating supplies and anodes, hangers and supports, equipment repair parts, etc., not chargeable to individual jobs.

(c) Fuel and power.

(d) Share of operating overhead (based on direct labor 91 plus indirect labor 92 (a) either

(*Concluded on page 64*)

Table II

Chart Showing Components Of Selling Price

- **Sales Price**
  - **Job Cost**
    - Metal Cost of Job
      - Raw Metals—41
      - Metal Expense—42
      - Shrinkage—43
    - Molding
      - Melting Labor—51
      - Burden—52
      - Labor—61
      - Burden—62
      - Materials—63
    - Core Making
      - Labor—71
      - Burden—72
      - Materials—73
    - Fabricating
      - Cleaning, Trimming, Rough Grinding & Sand Blasting
        - Labor—81
        - Burden—82
        - Materials—83
      - Machining, Polishing & Finishing
        - Labor—91
        - Burden—92
        - Materials—93
      - Inspection, Packing & Shipping
        - Labor—101
        - Burden—102
        - Materials—103
        - Delivery Expense—104
  - **Profit**
    - Interest on Investment—11
    - Interest on Debt—12
    - Dividends on Stock or Bonds—13
    - Research & Development Expense—14
    - Bad Accounts—15
    - Declines in Market Value of Inventory—16
    - Special Sales & Advertising Campaigns—17
  - **Burden**
    - Normalized
      - FIXED OVERHEAD
        - Rent—21
        - Building Maintenance & Watchmen—22
        - All Taxes except income & sales tax—23
        - Fire Insurance, and all other insurance (except workman's compensation, group life and health, unemployment insurance)—24
        - Depreciation of Buildings—25
        - Depreciation of Equipment—26
        - Administration & Office Expense, directors fees, dues, subscriptions, legal expense, auditing expense, etc.—27
        - Sales expense, commissions, advertising—28
      - OPERATING OVERHEAD
        - General plant labor—31
        - Plant supervision and plant office help—32
        - Fuel & power, supplies & tools in boiler & engine room—33
        - General supplies—34
        - Workman's compensation insurance—35
        - Loss on product scrapped, including returns from customers—36
        - Laboratory—37

Consumers' good-will toward STERLING Abrasives has been built through years of producing the best grinding wheels it is possible to make—wheels that consistently do the work required, consistently improved as industry progresses and consistently retaining good-will by their quality.

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Speed—4800 RPM. Cap. 6 x 2 x ¾ cup emery wheels, 7" or 9" abrasive discs, cup wire brushes. Wgt.—11 lbs. Especially designed for grinding weld seams, surfacing large castings, grinding dies and flat metal surfaces. Easy to exert maximum pressure while maintaining perfect balance.

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RUEMELIN SAND BLAST CABINETS

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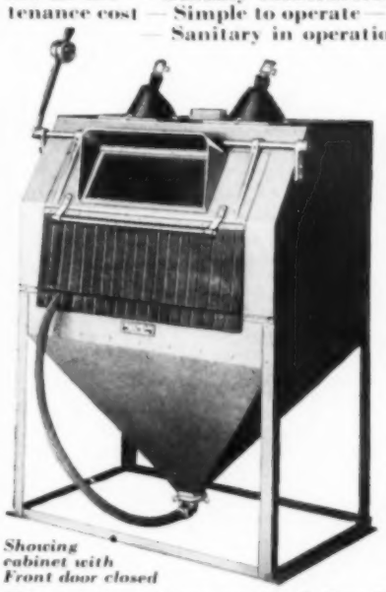
Have proven most practical in service. More than 500 in use — Durably constructed — Lowest Maintenance cost — Simple to operate — Moderately priced — Sanitary in operation.



Showing cabinet with Front door closed

The large front door swings open for quick access to inside of cabinet.

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RUEMELIN MFG. CO.

1587 S. First St. Milwaukee, Wis.

(*Concluded from page* 62)

man hours or payroll dollars).

(e) Share of fixed overhead (based on direct labor 91 plus indirect labor 92 (a) either man hours or payroll dollars).

93. Direct materials chargeable to individual jobs such as special cutters, tools, dies, grinding and polishing wheels, plating, racks, lacquers, paints.

X. *Inspection, Packing and Shipping Department.*

Cost per job in this department equals direct labor plus burden plus direct materials.

101. Direct labor which can be charged directly to individual jobs such as gaging, pressure testing, wrapping separately, making special cases, etc.

102. Burden—All other items, except direct materials chargeable to this department. Burden shall be proportioned to each job on basis of either total direct labor in dollars or direct labor total man hours.

(a) All labor not directly chargeable to individual jobs such as those indicated under direct labor and also repairing equipment, clean up labor, transportation of castings, marking and billing, foremen, clerks, truck drivers.

(b) Supplies and tools such as bags, boxes, crates, cartons, paper, etc., not chargeable to individual jobs.

(c) Fuel and power.

(d) Share or operating overhead (based on direct labor 101 plus indirect labor 102 (a) either man hours or payroll dollars).

Melts Bronze In Small Cupola

(*Concluded from page* 22)

melted and the castings poured. The two cards correspond to the two halves of the 500-pound charge.

If the entire 500 pound charge were tapped at once, the slag floating on top would sink to the bottom of the cupola. The coke below the tuyeres is not as hot as the coke in the melting zone. The comparatively sticky slag will cling to the coke in its descent. Thus a large amount of coke becomes covered with slag and under certain conditions some of this slag will unite with the metal. Hence the advisability of taking the metal in two taps. A No. 80 crucible will take half of the charge. The furnace is tapped when the charge is melted and one potfull is sent to the molding floor. The second pot is not filled until approximately 500 pounds of metal has accumulated in the well of the cupola. This prevents the slag from contaminating as much of the coke as it would if the cupola well was drained completely at each tap. One advantage of the crucible is that it can be made hotter than a lined ladle.

From time to time it may be necessary to add small quantities of zinc to compensate for loss through volatilization. Also about 3 ounces of phosphor copper is placed in the crucible before the metal is tapped. At the close of the day the bottom is dropped and after the drop has cooled the slag is removed from the lining. This is done more readily while the lining is still hot.

Approximate cost per ton of metal in the cupola may be reckoned as follows:

Coke	$2.08
Labor	.70
Lining	.65
Fan	.10
Preheating ladles	.28
Depreciation	.12
	$3.93

Metal recovery varies according to the composition of the charge. With ingots it will be 98.5 per cent and of course will be less from borings. There is no loss of tin or lead.

Casts Steel With External Chills

(*Concluded from Page* 23)

surface, chills should be cast from a chill pattern made to fit the casting surface. These chills impart a better finished appearance, save cleaning room labor, and are well worth the cost.

Chills for a large surface should be in sections, say 4 or 5 inches in maximum length and separated from each other by ⅛ or ¼-inch of sand. Care must be taken to prevent the formation of fins between the chills. Fins prevent proper contraction of the castings, cause the casting to crack and the chills stick to the casting.

Another function of external chills is to replace sharp corners and sharp edges of sand. Many defects at intersections in steel castings, usually termed *shrinks*, actually are caused by gases, concentrated at these sharp points or edges. They can be eliminated by the use of external chills cast to accurately fit the pattern, as in *A*, Fig. 2. Where a rod is used for the chill, the thin edge of sand as shown at *B* will break off under the action of the molten metal. This not only causes local dirt, but the reaction of the loose sand particles on the molten metal evolves a lot of gas. Corner chills will not stick if suitably coated with shellac and dry sand.

The proper use of external chills will enable the foundryman to increase the yield of good casting by reducing the size of risers. However, probably the safest practice, and the most economical, for regular carbon steel castings is to confine the use of external chills to sections otherwise difficult or impossible to feed by risers. With certain alloys not recoverable on re-melt, the use of external chills to increase yield may be profitable. Certain alloys are subject to cracking if cut with a torch while cold, or when being ground. If risers on these castings can be reduced by the use of external chills, this hazard may be greatly reduced.

A thorough investigation into the solidity of intersections of steel castings at times will disclose sections not as solid as supposed. Where the apparently sound metal as indicated by a saw cut may appear convincing, an etching of the surface often will disclose unsoundness. These investigations have led to the use of external chills even where internal chills formerly were not considered necessary. In extremely heavy sections this unsoundness is more pronounced, having, in addition to possible cavities, an enlargement of grain size. Due to the mass of these sections, the coarseness is difficult to correct by heat treatment. In these cases external chills are extremely valuable. In most alloy steels, especially those high in chromium or manganese, the sponginess of intersections is more pronounced than in carbon steels. In these cases, the use of external chills is doubly important.

The Adventures of Bill

(*Concluded from Page* 51)

"However, the castings also may be made in the ordinary manner in a 16 x 20-inch sand mold with eight patterns mounted, half on each side of a matchplate, and poured in groups of four. The output will compare favorably with the output of a permanent mold. In one method two matchplates will be required. The half patterns are mounted on one side of the plate and the obverse side will form the corebox. Thus after the two halves of the mold are made, the two halves of the corebox are filled with sand reinforced with one or two small rods. The two halves are brought together—booked is the foundry term—then one half of the corebox is removed. The drag flask is placed over the cores and drag and plate are rolled over. The core plate then is removed and the cope placed in position. Each continuous core serves two molds and eliminates the use of chaplets for support.

"The core should be flattened off slightly under the recessed letters on the outside of the casting to increase the thickness of metal. The long and ornamental tail under the letter *g* is a potential source of cold shuts and a crack. If the casting is made in a permanent mold the letters will be in relief.

ADVERTISING PAGES OMITTED

Reactions in Cupola Refractories

(*Concluded from Page 28*)

tion $3A1_2O_3.2SiO_2$ if fused at temperatures only slightly above 3290 degrees Fahr. would show a dense stucture, thoroughly uniform, no softening range, high resistance to all slag action, high resistance to abrasion and load deformation. A brick of fused composition 94 per cent silica would show a fusion point of only 2810 degrees Fahr. and no intermediate softening range; high expansion under heat, and high rate of spalling.

Practically refractories do not exhibit these properties. In the light of this diagram, the actual behavior of refractories is best interpreted if we assume that they are not compounds whose composition would correspond to their position on this diagram; but rather are mixtures of materials in a solid or semisolid state, at appropriate temperatures, in greater or lesser intimate contact. Each exhibits its own individual properties and is undergoing slow internal chemical interaction between its constituent parts, tending to form the eutectic, mullite and to precipitate the excess above that composition.

Mullite Structure

Thus the fused mullite brick is fused at temperatures above its fusion point and so cast and cooled that its crystal structure is coarse. It does show a great many of the expected properties. Other refractories are not actually fused in burning. They are merely agglomerated or vitrified, and the complex properties obtained are due to the partial internal readjustment which is going on progressively within the burnt blocks in use.

The temperature of transformation to mullite in blocks is 2012 degrees Fahr. Thus, although all refractories are solid at this low temperature, indications are strong that this temperature is the true critical point in any refractory mixture, and that in any mixture of silica and alumina existing above 2012 degrees Fahr. the perponderant tendency is for the progressive formation of this constituent and the reprecipitation of the excess alumina or silica. Much needed work must be done to demonstrate this conclusively.

As commercial refractories are burned at temperatures not greatly exceeding the formation point of mullite, neither time nor temperature favor the formation of mullite in the process; nor in most cases of use does a refractory become totally transformed.

There is instead a progressive reaction occurring in the melting zone of a cupola. At the hottest side of the refractory there is formation of mullite and the assumption of the properties of mullite by the refractory. At the same time there is also progressive formation and fusion at that surface of a series of slag compounds whose viscosity and fusion point decrease progressively away from the refractory.

It has been demonstrated microscopically that no mullite composition block shows excess silica glass or excess alumina below the slag surface, and that its properties do not change materially with time and use. On the other hand refractories of higher alumina content eventually show free alumina and become embrittled. Most refractories have excess silica and this appears microscopically as free silica or as a fused silica glass matrix in which crystals of mullite are imbedded.

Such an interpretation accounts for the well recognized fact that overburnt blocks give longer refractory life in the melting zone, for there has been more time for the preformation of mullite. Similarly fine grog, intimately mixed and long burned aids in this tendency.

Silica brick, although often of chemical composition corresponding to the utectic mixture, exhibits little of the expected properties; because by far the largest part of its silica content is in the form of pure silica grain. The high resistance to slag erosion of silica materials such as firestone and mica schist in the melting zones is largely explained by the formation of a fused silica glass at the hot surface of the stone which seals the pores to further slagging and forms a binding matrix to hold the silica grains together.

E. E. Marbaker and others have indicated the manner of selection of cupola refractories. With the knowledge that different zones require divergent properties selection is somewhat easier, than just price.

Immediately opposite the charging door many foundries have used cast iron blocks to withstand mechanical charging service. They are subject to expansion and grain growth and allowance should be made for this expansion.

In the melting zone and slightly above the bed it is practical to line the cupola with high grade block or, as is often done, with firestone or mica schist. Firestone and mica schist require more skill to lay up, and their effectiveness depends to a large extent on the amount and kind of clay with which they are laid. Too often, as in patching, there is too much clay used with not enough grog material to reduce the inevitable shrinkage of the clay.

Other Refractory Needs

In the crucible nothing less than high burned, clay block should be used, to reduce any ill effects on the metal.

Most ladles are made of raw clay. The walls are subject to two destructive factors; Extreme and rapid changes of metal level and temperature. Desirable properties are high fusion point, extreme resistance to spalling, low slag reactivity, and freedom from impurities affecting the metal. To gain these it is necessary to make a dense lining showing little or no shrinkage on drying and cohesiveness in the refractory to prevent mechanical carrying over of slag into the mold.

Next best to a shape or block lining is a rammed up lining of either finely ground grog and a high grade fireclay, or a mixture of crushed ganister and clay. Depending on the clay, the proportions of this filler material should vary between 40 and 70 per cent. Core sand ranks third as a filler material, but is most popularly used.

Red molding sands so often used in both cupola and ladles have no justification either economically or chemically and frequently is the cause of so called slag occlusions in castings.

Studies Behavior

PROBLEMS pertaining to cupola refractories require careful consideration on the part of the foundryman. Variations found in the four zones of the cupola place definite demands on refractories. Unless the proper refractory is selected for each zone, it is likely that the unit will not function with maximum efficiency, the amount of patching required will be excessive and therefore the cost of operation will be high. This article, which is from a paper presented at the foundry short course conducted in April by the mechanical engineering department of Michigan State College of Agriculture and Applied Science at East Lansing, Mich., discusses the properties and behavior of refractories for cupola use. The author is a foundry consultant at Ypsilanti, Mich.

Make Personnel Changes

G. H. Burkholder, formerly of Philadelphia, has been appointed Western sales manager of the positive drive division, Link-Belt Co., with headquarters at Indianapolis. W. H. Kinkead has been made manager of sales of speed reducers, with headquarters in Philadelphia, succeeding Mr. Burkholder. G. L. Gansz succeeds Mr. Kinkead, in charge of the positive drive division for the

European Foundry Practice

Digest of recent literature covering various phases of castings manufacture

Chilling Test Piece

Chilling Anomalies in Cast-Irons and Their Relation to Uniformity of Manufacture, (Les Anomalies de Trempe des Fontes et Leur Rapport Avec la Regularite des Fabrications), by A. Le Thomas. *Bulletin* of the Association Technique de Fonderie, Paris, June, 1934.

It is necessary that the founder have a knowledge of the factors governing the tendencies of iron and carbon to combine or to remain in a free state in cast-iron. Two factors are of special interest: The rate of cooling, which depends to a large extent upon the thickness of the casting; and the chemical composition, in which the silicon plays an important part.

One of the ways in which these influences can be detected without resorting to the determination of carbon by chemical analysis is by using a chilling test, and a special form of test-piece for that purpose is described. This test-piece gives a measure of the aptitude to chilling of a given cast-iron. Experience has shown on numerous occasions that irons having the same chemical composition and which are used under identical conditions have different physical and mechanical properties, this being the result of the fact that the proportion of combined carbon is abnormally high. Concurrently with this factor, it is found that the aptitude to chilling does not seem to be dependent exclusively upon the usual chemical composition, particularly with regard to silicon.

These anomalies and the abnormal tendency to chilling are due principally to excess of sulphur and to oxidation. These effects are dealt with separately.

With regard to the effect of sulphur, it is pointed out that it happens that certain castings present hard spots, and by taking a test with a chilling test-piece from the iron, it is found that the aptitude to chilling shows an abnormal increase. A number of castings presenting this defect have been investigated systematically by the author, and he has found that all irons presenting this defect also present the characteristics either that the sulphur content is high or that the manganese content is low. No case has been observed where hard spots or inverted chill have occurred when the iron has a normal content of manganese (0.6 to 1.0 per cent) and less than 0.08 per cent of sulphur. Furthermore, all the irons giving rise to the defect had a relatively high content of phosphorus —not less than 0.98 per cent.

If in a given iron the manganese content is relatively low and the sulphur content relatively high, there will be a formation of iron-sulphide which remains dissolved in the iron and which gives the iron the chilling properties that have been observed. It was found that the castings presenting the defects were made with iron for which too large a proportion of scrap had been used in making up the charge, and this scrap, after being remelted a number of times, shows a decrease in manganese content and an increase in sulphur content.

To limit the proportion of sulphur, it is recommended: (1) To avoid using too sulphurous a coke—preferably not more than 1.00 per cent sulphur; (2) The iron can be desulphurized by the fused soda-ash process, although this may not be absolutely necessary if proper control otherwise is effected; (3) The exaggerated use of indiscriminate scrap should be avoided; (4) It is advisable to use in each charge of the cupola a relatively high proportion of new pig iron.

To maintain the manganese at a proper figure, the choice of grade of pig iron should be made carefully, so that the manganese content should be as high as possible; and it is advisable in some cases to add to the charge, or sometimes in the ladle, either ferromanganese or spiegel.

The effect of oxidation on inverted chill and on abnormal chilling of the iron has been shown by heating a certain amount of melted iron in crucible and maintaining the bath in contact with the atmosphere. It was found that the aptitude to chilling increased during the time in which the molten iron was in contact with the air, although the chemical composition of the iron remained practically unchanged. If, on the other hand, the bath is kept at the melting temperature without contact with the atmosphere, or if the bath has been deoxidized after contact with the atmosphere, the chilling anomalies do not present themselves. It is pointed out further that if an iron that has been oxidized and which, therefore, has a tendency to chill abnormally is remelted, the anomaly persists. This is a case of heredity, which does not occur when the iron has been deliberately chilled by being cooled in contact with a chilling medium, such as in die-casting. A number of experiments were made to confirm this theory, and in the course of those experiments a number of additions were made to the charge to find the effect of such additions on chilling anomalies. It was also found in the experiments that, concurrently with this chilling, the iron shows a tendency to porosity.

In his concluding remarks, the author strongly recommends the use of the chilling test-piece, as it enables the founder to detect certain causes of rejection, due to exaggerated sulphuration or oxidation. He also emphasizes the fact that it pays the founder to use the best-quality material in making up his charges, as he thus substantially reduces his wasters.

Recommends Converter

Steel Castings with Special Reference to the Tropenas Process, by J. E. Mercer and D. K. Barclay, the *Foundry Trade Journal*, May 31, 1934.

By its flexibility and ease of control, the converter offers the steel founder a convenient and economical method for supplying excellent steel for light and medium castings. As the converter is lined with acid material, no reduction of impurities, sulphur and phosphorus, takes place, but an increase of sulphur from the cupola coke usually amounting to about 0.06 per cent is noticed. A slight increase in phosphorus may be expected.

Blast is admitted to the tuyeres at about 3-pounds per square inch. At the beginning some iron is oxidized to ferrous oxide, and if the temperature of the iron has been correct, the vessel soon lights up. Order of oxidation development will be, silicon, manganese

(*Concluded on Page* 70)

Simplicity Gyrating Screens

The 2' x 3' Screen illustrated is screening 14 tons per hour of Molding Sand through a $\frac{1}{16}$" opening.

Capacities ranging up to 300 tons per hour are being handled by Simplicity Screens with production costs and metal scrap losses definitely lowered.

A prominent European foundry installed two Simplicity Screens last winter to clean and aerate Molding Sand. Additional units now being ordered prove their success. The Simplicity Shake-Out Screen is also unsurpassed for cleaning castings and flasks.

Why not install Simplicity Screens and secure these same valuable results in your own foundry. Every Simplicity installation guaranteed unconditionally.

Simplicity Engineering Company

Durand, Michigan

For Canada: Waterous Limited, Brantford, Ontario

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Ellwood Foundry Nails are available in sizes from ½" to 8".

Makers of foundry nails for 20 years!

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(*Pittsburgh District*)

Your lining costs can be reduced by using

STONE CUPOLA BLOCKS

Sawed in regular sizes, wedge shapes from our extensive quarries of

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Sawed 2 Sides Slabs
Sawed 4 Sides Blocks
Sawed 6 Sides Blocks
Slag Hole Blocks
Acid Tank Linings
Air Furnace Bottom Sand
Drop Forge Furnace Bottoms
Silica Flour
Abrasive Sand and Grits

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THE CLEVELAND QUARRIES COMPANY

Builders Exchange Bldg., Cleveland, Ohio

(*Concluded from page* 68)

and carbon, with some oxidation of iron to ferrous oxide. As the silicon, manganese, and carbon content in their reaction with oxygen afford a considerable amount of additional calories for the blast, their combustion throughout the blow must be regulated carefully. Oxidation of silicon is recognizable in the violent eruption known as the boil which takes place within the vessel. Oxygen combines with the carbon forming carbon monoxide which burns to carbon dioxide in the mouth of the vessel. As the carbon burns off, the flame diminishes in size and finally just overtips the mouth of the furnace, denoting the end of the blow.

The following analysis of slag previous to addition of deoxidizers may be of interest: Silica, 62.10 per cent; iron oxide, 26.62 per cent; alumina, 1.21 per cent; manganese oxide, 9.71 per cent; calcium oxide, 0.40 per cent; and magnesia trace.

Deoxidizers are various and include ferroalloys of silicon, manganese and titanium; also aluminum and calcium or combination of two or more of these elements. They may be added to the bath in solid or liquid form. Converter steel may be carborized to an extent with liquid iron from the cupola.

Function of Blackings

Functions of Blackings

Blackings and Partings. (Decapants) by the Technical Committee of the Association Technique de Fonderie de Belgique. *La Fonderie Belge*, Liege, March-April, 1934.

Blackings operate in three ways: (a) By isolating the metal from the sand; (b) By a cooling influence, due to the volatilization of the volatile matters contained in the blackings; (c) By diluting the calories concentrated on the surface of the mold, due to the conductivity of the carbon.

When blackings act by cooling the surfaces in contact, care should be taken that this cooling is not rapid enough to transform the iron into white iron. Therefore, the blackings or partings must be used in limited quantities, and their qualities should be known. Furthermore, in the case of massive castings, part of the volatile matter contained in the blacking can react on the metal and reduce its qualities.

Certain precautions must be taken in applying b'acking to the mold. In particular the surface of the mold never should be wetted before the blacking is applied. There are cases where a layer of linseed oil is applied over the blacking. Only crude linseed oil should be used, and it should be applied only in one layer, several hours after the blacking has been applied.

Reference is made to tests effected by Ben Hird in England and J. Varlet in Belgium. Both investigators have arrived at similar results and have brought out the favorable influence of blackings containing a relatively large percentage of volatile matter.

Sulphur in Iron

Origins of Sulphur in Cast Iron. (Les Origines du Soufre dans la Fonte), by Marcel Olinger. *La Fonte*, Paris, January-March, 1934.

Sulphur being one of the metalloids most frequently found in nature, it is present in almost every constituent of the charge going into a blast furnace or cupola, but the main source of sulphur is in the coke, where the total generally is around 0.9 or 1 per cent.

In the blast furnace, desulphurization is effected by lime and manganese. In the manganese process a certain quantity of manganese-sulphide is absorbed in the iron. The manufacture of foundry irons requires the use of limestone and a high temperature to enable the carbon and the silicon to be incorporated in the iron. Under these conditions, desulphurization can be pushed far, and when sulphur makes its appearance it generally indicates that the operation of the furnace is abnormal.

It is easy to recognize a sulphurous iron when it is running; it wets the sand, smokes, and its surface is covered by characteristic film. It is to be noted that desulphurization takes place during the running process. Sulphurous pigs are noticeable by the crumpled aspect of the skin, the dull appearance of the fracture, and a large number of blowholes.

Various methods of analyzing the amount of sulphur in cast iron are indicated.

Weight of Castings

Estimating the Weight of Castings. (La Prevision du Poids des Pieces Coulees), by Guy Henon. *La Fonte*, Paris, January-March, 1934.

Indications of weight given on drawings are uncertain. A complete method for determining the weight of a casting with reasonable precision is to separate the casting in a number of geometrical solids of simple shape, of which the volumes can be determined separately. These volumes are added together, and from the total the volumes of the hollow parts are deducted. The resulting figure is rounded up to take account of fillets, etc., and the figure is then multiplied by the density of the metal, the result being increased by from 2 to 15 per cent, to take account of various corrections due to the methods of executing the pattern and the mold.

Theoretically, this method is the best; but the separation into elemental volumes must be done judiciously, and it is necessary to be very familiar with foundry practice to apply the various necessary corrections.

It is sometimes possible to follow a more rapid method of calculation by simplifying the shape of the casting, but in this case the result is not quite so precise.

It is possible to calculate the weight of a casting by using the pattern, but with a casting containing a number of cores, especially if the casting is complicated, it is necessary to estimate the thicknesses of the parts.

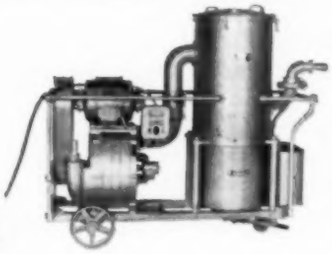
Another method is to compare the casting with similar ones of which the weight is known. If the weight of the casting to be estimated appears to be comprised between the weights of two similar castings, the unknown weight can be interpolated. If the casting can be estimated as slightly smaller or larger than a known casting, its weight can be extrapolated. In the case of a casting which is not complicated and is almost free from cores, a simple measure is to weigh the pattern and to use a table of coefficients. Knowing the nature of the material from which the pattern is made, it is only required to multiply the weight of the pattern by the proper coefficient to have a good approximation of the weight of the casting.

Chilled Iron Rolls

Hardness and Chill Depth of Alloy Chilled Castings (Ueber die Haerte und Schrecktiefe des legierten Schalenhartgusses) , by Emil Schuez, Die Giesserei, Duesseldorf, Germany, Aug. 3, 1934.

In contrast to gray iron, the hardness of white iron and the chilled layer of chilled castings is related directly to the carbon content of the iron. The author mentions an earlier work prepared in collaboration with Pohl wherein the formula 16.67 carbon content plus 13 equals the Shore (German instrument) hardness, was developed. He then calls attention to a difference in readings obtained with German and American instruments of that type, showing curves of the two instruments in relation to brinell hardness.

Discussion of those phases by the author is to permit a better interpretation for the reader of the results recently published by Taniguchi, Imperial Steel Works, Yawata, Japan, on alloy chilled rolls. Tanaguchi's results are presented with comparisons obtained from investigations by the author. These include effects on hardness of various alloying agents in addition to those ordinarily found in roll cast irons. Taniguchi's work indicates that the best results are obtained from rolls lying in a zone or field bounded by the following alloy contents at the four corners: 1.2 per cent chromium and 3.3 per cent nickel; 1.6 chromium and 4.3 per cent nickel; 0.2 per cent chromium and 3.9 per cent nickel, and 0.5 per cent chromium and 4.8 per cent nickel.



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OF TWISTED STEEL

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The spiral twist permits the use of much smaller gaggers and at the same time provides more than four times the grip on the sand when compared with a larger size deformed bar gagger.

We are also manufacturers of twisted tempered steel tumbling barrel stars.

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HOTEL SINTON ST. NICHOLAS

Obituary

WILLIAM H. OSBORNE, 80, chairman of the board, Lakeside Malleable Castings Co., Racine, Wis., died in Milwaukee Aug. 13. Mr. Osborne was born in Tecumseh, Mich. and went to Milwaukee in 1870. He founded the Wisconsin Malleable Iron & Steel Co., in 1878 and later established the Lakeside company.

♦ ♦ ♦

Frederic W. Howe, vice president Crompton & Knowles Loom Works, Worcester, Mass., died recently at Providence, R. I. Mr. Howe was manager of the company's plant at Providence previous to its removal to Worcester in 1932 and had been connected with the company since 1901.

♦ ♦ ♦

Walter L. Stallings, 40, for the past 9 years superintendent of the Agricola Furnace Co. and the Wetter Pipe Co., Gadsden, Ala., died Aug. 2. Mr. Stallings was superintendent of the Gadsden Pipe Co. for 10 years prior to his connection with the previously mentioned companies.

♦ ♦ ♦

Frederick H. Miller, 78, one of the founders of the Lamp & Miller Mfg. Co., pioneer Milwaukee brass foundry, died recently. Mr. Miller was born in Milwaukee and was a life-long resident of that city. With W. A. Lamp he established the foundry in 1887.

♦ ♦ ♦

P. C. Leonard, district sales manager at Chicago for General Refractories Co., died at Chicago recently. He had been with General Refractories Co. since 1923, previous to which he was identified with the American Refractories Co.

♦ ♦ ♦

Thomas D. Webb, 69, vice president, American Laundry Machinery Co., died recently at his summer home on Long Island, N. Y. He had been connected with the company since 1894.

♦ ♦ ♦

Frank B. Reed, 82, former head of the Clearfield Machine Co., Clearfield, Pa., died at Clearfield recently.

♦ ♦ ♦

Andrew O'Rourke, 74, brass foundry superintendent, Crane Co., Chicago, died recently. Mr. O'Rourke was an employe of the Crane Co. since 1880.

♦ ♦ ♦

William E. McGraw, 57, well known foundryman in the Cleveland district died Aug. 2. Mr. McGraw learned the molding trade in the Fulton foundry at that time located at the foot of Marquette street, and later at different periods was foundry superintendent at the plants of the Fulton Foundry & Machine Co. and the Cuyahoga Foundry Co., Cleveland.

Metal Congress To Meet in New York

National Metal Congress and Exposition will be held Oct. 1-5 at the Port Authority building, New York, under the auspices of the American Society for Metals. Technical sessions of the congress will be held at the Hotel Pennsylvania and the Hotel New Yorker.

The Institute of Metals and Iron and Steel divisions of the A.I.M.E. and the Iron and Steel division of the A.S.M.E. will meet during the congress.

Detroit Founders Stage Golf Tournament

Detroit Foundrymen's association held its annual golf tournament on Aug. 16, with a good attendance. One of the guests of the afternoon was Judge Guy Miller of Detroit who won the main golf prize, a handsome leather bag donated by Warner G. Thompson Co. Other prizes were provided by the Sand Products Corp., Ayers Mineral Co., and the Great Lakes Foundry Sand Co. The meeting was conducted by the president, Harry Rayner, and the tournament by Frank Muschinski, American Car & Foundry Co., chairman of the entertainment committee.

The meeting to be held on Oct. 18, will open the educational season of the association. J. J. Boland, Griffin Wheel Co., Chicago, and former president of the Detroit Foundrymen's association, will talk on "Hot-Blast Cupolas."

Book Review

The New Background of Science, by Sir James Jeans, cloth, 300 pages, 5 x 8 inches, published by the MacMillan Co., New York, and supplied by THE FOUNDRY, Cleveland, for $2.50 plus 15 cents postage, and in Europe by the Penton Publishing Co., Ltd., Caxton House, Westminster, London.

While the author explains that he has attempted to depict the present situation with regard to theoretical physics, the inability to attain the desired precision of thought without the use of mathematical symbols and formulae probably will make the book difficult for the reader not expressly familiar with higher mathematics.

The text discusses the way in which scientists came to search for and find a new background such as should effect reconciliation between the nature of the laboratory and the nature of everyday experience; the scientific advances made by Einstein, Bohr, Husenberg, and others; how the theory of relativity has displaced Newton's theory of gravitation, how science has extended the range and amplification power of our senses, and the implications of the present position in physical science.

Carborundum Plans New Series of Programs

The 1934-35 radio program of the Carborundum Co., Niagara Falls, N. Y., is scheduled for Saturday night from 10 to 10:30, Eastern Standard time, beginning Oct. 20, over a coast-to-coast network of the Columbia Broadcasting system. This is the ninth season for this program and again will feature the band under the direction of Edward D'Anna and the telling of Indian legends and instructive industrial stories.

Francis D. Bowman, advertising manager, the Carborundum Co., will continue to write, produce and announce the programs.

A.S.T.M. Board Will Act on Vacancy

American Society for Testing Materials will make no decision concerning the successor to the late William H. Bassett, as president of that organization until the fall meeting of the executive committee. That committee is authorized to fill any vacancy occurring by death or otherwise in the officer's ranks. Dr. Hermann von Schrenk, consulting engineer, St. Louis, as senior vice president, will assume temporarily the duties of the presidency.

Purchases Company

R-S Products Corp., Germantown avenue at Wayne junction, Philadelphia, has purchased all the assets of patent rights, good will, etc., of Ryan, Scully & Co. The purchase is the result of an initial step taken over a year ago when the corporation entered in to a contract to take over the organization and the control of Ryan, Scully & Co.

The engineering department has been placed under the direction of J. A. Ehlinger. F. J. Ryan is president of the corporation.

St. John X-Ray Service, Inc. plans to conduct a course in making and interpreting radiographs at the laboratory of the firm, 30 Thomson avenue, Long Island City, New York, during the week of Oct. 8.

New England Group Holds Annual Outing

The annual outing of the New England Foundrymen's association was held Aug. 8 at the Pomham club on the shores of Narrangansett Bay, below Providence, R. I., and was attended by approximately 100 members and guests. A feature was a Rhode Island clambake, a cabaret and sports, the latter being largely of the indoor variety. Prizes for the originally planned outdoor sports program were awarded by lot.

J. R. Cooney, Paxson-Taggert Inc., Providence, was awarded a free dinner for guessing the nearest number of clams used in the bake and by actual count by the club steward, there were 3841 bivalves slaughtered. For coming the longest distance, R. C. Mills, the Manufacturers' Foundry Co., Waterbury, Conn., also was awarded a free dinner. Winners in the "sports" program, drawn by an impartial outsider from a hat and announced by Fred Clark, Whitehead Bros. Co. in a voice heard across the bay were: T. E. Palmer, Old Colony Foundry, East Bridgewater, Mass.; Wilbur Forbes, Glenwood Range Co., Taunton, Mass.; Victor Hillman, Crompton & Knowles Loom Works, Worcester, Mass.; C. R. Burkhardt, Framingham Foundries, Framingham, Mass.; F. C. Jones, the Gorham Co., Providence, R. I., and C. F. Hutchins, New England Coal & Coke Co., Boston.

The committee, composed of Providence members of the association included: Walter M. Saunders Jr., consulting chemist, Providence, chairman Edward F. Parks, Universal Winding Co.; Charles E. Andrews, Whitehead Bros. Co., Leroy M. Sherwin, Brown & Sharpe Mfg. Co.; Charles Colvin, Colvin Foundry Co.; Fred Clark, Whitehead Bros. Co., and W. G. Rich, Providence Gas Co.

Reports Gain in High Frequency Furnaces

One of the important metallurgical developments in recent years has been the perfection of the high frequency electric induction furnace for melting steel or iron and their alloys, and nonferrous metals, according to a recent article in *Steel* by Edwin F. Cone. The pioneer in that field has been E. F. Northrup, vice president and technical adviser, Ajax Electrothermic Corp., Trenton, N. J.

Through the co-operation of that company the author presented data which show that there are 94 furnaces of the high frequency type in the United States and 6 in Canada, operating commercially in melting iron, steel and their alloys, nonferrous metals and alloys, and in experimental and miscellaneous operations. The total does not include steel mill, research and college laboratory installations.

As shown in the accompanying table, of the 94 furnaces operating commercially in this country, 46 are for iron, steel and alloys; 36 for nonferrous metals and alloys; and 12 are in operation for experimental and miscellaneous uses.

The largest units—those of, 8000 4250, 3000 and 2000 pounds capacity each—are operating on steels. Of the 15 units of 1000-pound capacity, 13 are on steel and 2 on nonferrous metals. There are 22 furnaces of 650-pound capacity, all on nonferrous metals and alloys, with 11 of the 600-pound type on steel. Most of the smaller sized units are on steel with a few on nonferrous and special work.

Besides the 96 furnaces of 11,695 kilowatts of furnace capacity in the United States and Canada, there are about 30,000 kilowatts of furnace capacity installed in Austria, Belgium, Denmark, England, France, Germany, Hungary, Italy, Japan, Poland, Russia, Spain, Sweden, and Switzerland. Small equipments have also been installed in Czechoslovakia, Holland, Persia, Scotland, Wales, Afghanistan, Brazil, China and South Africa.

There is a 4-ton, or 8000-pound furnace in Sweden of 1200-kilowatt capacity, comparing closely with the same type in the United States. In England, at the plant of Samuel Fox & Co., there is a 5-ton, 1350-kilowatt unit. A 4-ton, 1400-kilowatt melting furnace also is installed in Krupp's in Germany. A Swedish installation has a 5-ton furnace for taking liquid charges, and there is a projected 7 to 8-ton furnace for the same purpose.

The principle of inductive heating recently has entered the field of heat treating.

Furnaces Installed

United States

For Melting	No.	Kw.-Hr.
Iron, steel and alloys	46	7,195
Nonferrous	36	2,975
Experimental and miscellaneous	12	975
Total	94	11,145

Canada

Experimental, nonferrous and miscellaneous	6	550
Total, U. S. and Canada	100	11,695
Steel mill, research and college laboratories		3,600
Grand total		15,295

United States

Size in pounds	Number
8,000	2
4,250	1
3,000	1
2,000	6
1,000	15
950	1
650	22
600	13
500	3
450	2
400	1
300	6
225	2
200	1
150	4
100	10
50	3
17	1
22,842 (Total)	94

Made Works Manager

T. A. Renkenberger (See Foundry Album, page 34) recently was made works manager of the Herman Pneumatic Machine Co., Pittsburgh. Mr. Renkenberger served his apprenticeship in the foundry and machine shop of the Enterprise Mfg. Co., Columbiana, O., from 1911 to 1914. He then accepted a position as draftsman with the Republic Steel Corp., Youngstown, O., and in 1918 became associated with W. T. Martersteck, foundry and steel mill consulting engineer. Later, he was made designing and construction engineer with the Banner Machine Co., Columbiana, O., and in 1919 went to Zelienople, Pa., for the construction and installation of the Universal Rubber Product Co. plant.

In 1922 he became connected with the Herman Pneumatic Machine Co. as chief engineer and in 1928 was made general superintendent. Two years later he was appointed assistant works manager of that company.

Book Review

The Thermodynamics of Electrical Phenomena in Metals, by P. W. Bridgeman, cloth, 200 pages 6 x 8¾ inches, published by the Macmillan Co., New York and supplied by THE FOUNDRY, Cleveland for $3.75 plus 15 cents postage and in Europe by the Penton Publishing Co. Ltd., London.

Much more extensive use than generally is realized may be made of the broad principles of thermodynamics in discussing the electrical properties of metals. This book attempts a more or less systematic application of classical thermodynamics to those electrical phenomena amenable to thermodynamic treatment. In laying the basis for the thermodynamic attack a reexamination of electrical concepts is necessary, and it is found that the classical concepts are not broad enough completely to cover the domain of experiment. Thermodynamic argument then shows a number of necessary relations, not generally known between various electrical effects.

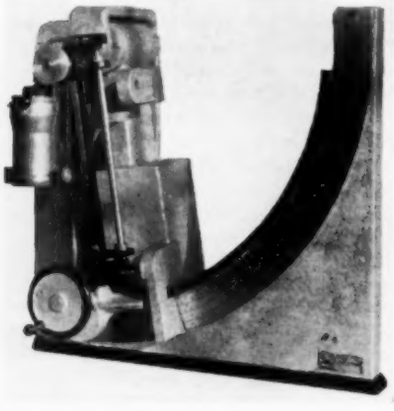
The author has been on the staff of Harvard university for 25 years and is the author of *The Logic of Modern Physics* and *The Physics of High Pressure*.

New Equipment

For Foundries

Accessory Gives Tensile Strength of Sand

Harry W. Dietert Co., 676 West Grand boulevard, Detroit, has introduced a tensile sand strength accessory which may be attached to its



The accessory is attached to the strength machine to determine green or dry strength

strength machine to test the green and dry tensile strength of molding sands. The equipment consists of two major parts, the tensile specimen tube holder and the loading mechanism. The tensile tube holder bolts to the pivot shaft of the strength machine. A hardened steel base with the aid of two clamping screws holds the tensile specimen tube rigidly in place during the test.

The loading mechanism is mounted on an aluminum frame having two hardened studs which enter the upper and lower test.position holes of the pusher arm of the strength machine to hold it in position. A steel shaft mounted on dust protected ball bearings supports the pendulum weight on its lower end. On the upper end of the shaft the load is transferred through a bronze ball chain to the upper half of the sand specimen in the tensile specimen tube.

The tensile specimen tube consists of three parts, namely, the tube proper, specimen grip and cup pedestal. The tube is made of a thick wall brass casting accurately machined to size. The specimen grip which holds the upper half of the sand specimen seats itself into the tube proper on a self-freezing taper. The cup pedestal fits around the bottom of the tube holding the specimen grip in place while ramming the sand in the tube.

The sand sample is placed in the tensile specimen tube and rammed with three drops of the sand rammer weight. The cup pedestal then is removed and the specimen tube is attached to the tensile test accessory. The sand specimen is loaded by turning the hand wheel of the strength machine and recording the maximum dry shear scale reading in grams.

The dry tensile strength of molding sand is determined in the same manner as the green test with the exception that the sand specimen is baked in the tensile specimen tube for 2 hours at 212 degrees Fahr. The short fulcrumed pivot point on the tensile test accessory is folded back and the long fulcrumed pivot point is swung into place. The readings of the dry share scale is multiplied by five to obtain the dry tensile strength in grams.

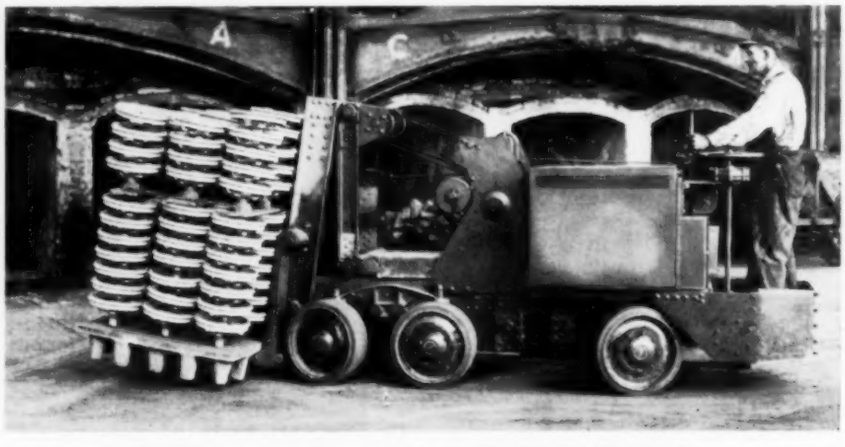
Liquid Carburizer

E. F. Houghton & Co., 240 West Somerset street, Philadelphia, recently has introduced a new liquid carburizer which may be used for heat treatment of castings where a liquid bath of sufficient size is available for handling such work. Features claimed for the carburizer include: Uniformity in depth of case and carbon content; low cost; longer pot life; no decarburization; high thermoconductivity; low consumption; reduced heating time; and no rust after water quenching.

Handles Castings In Malleable Foundry

A special, heavy duty fork truck recently has been developed by the Baker Industrial Truck division of the Baker-Raulang Co., Cleveland, for charging annealing ovens in a large mid-western malleable foundry. Height of the load and of the low oven door limit the underneath clearance to approximately 5 inches, thus necessitating the use of a truck of the overhanging fork type in which, in the low position, the forks lie close to and parallel to the floor. In operation, the forks raise about 6 inches and tilt simultaneously, thus cradling the load and correcting for droop.

As that form of loading magnifies the tire pressure due to the cantilever action, a compensating tandem trailing axle has been incorporated in the design. The load end of the frame is connected to this assembly by rocker arms and shaft and four sets of coil springs, thus allowing independent



In operation the forks raise and tilt simultaneously

vertical motion of each wheel. The off-center location of the rocker arm fulcrum distributes the load 60 per cent to the trailing wheels and 40 per cent to the driving wheels.

All wheels are equipped with 20 x 7 inch tires and all wheels steer about a common center, steering being accomplished by a hand wheel actuated cam and lever type steering gear. The truck also can be used for transporting heavy loads where tiering is not required. The rated capacity is 10,000 pounds with a 30-inch length of load. However, it can be made to accommodate longer loads by a proportional reduction in weight or, within reasonable limits, by increasing the wheelbase.

Foundry Ladles Are Insulated and Covered

Modern Equipment Co., Port Washington, Wis., recently has developed a line of covered and insulated ladles for a wide variety of foundry uses. The ladle cover is designed with a mechanism which permits it to be swung to the side for filling or inspection.

The cover is supported on a swivel bracket at the back of the ladle, on which it is raised and swung aside with a lever. It is lined with a high heat resisting refractory, and when closed, the rim fits snugly over the side of the ladle. When lining the ladle this cover can be removed entirely. The cover also may be supplied for equipping existing ladles.

It is claimed that larger amounts of metal can be distributed and held for a longer period by using the insulated cover. It is also pointed out that the cover makes it more agreeable for pouring and distributing the metal, by protecting the men from heat and gases. Views of the ladle equipment and cover are shown in the accompanying illustration.

Recording Thermometer Is Portable

Foxboro Co., Foxboro, Mass., recently has introduced a new portable recording thermometer. Because of the varying requirements of industry, the portable unit is supplied with either self-contained or long distance type thermometers in 8 or 10-inch case sizes.

A companion instrument with the same features is used to record pressures. Each of the instruments can be removed from its stand by simply unscrewing three bolts, or they may be fastened to a wall or board for permanent use if desired.

Provides Standard Analyzed Alloy Sample

British Chemical Standards headquarters has for some time been supervising the preparation and analyses of a new sample of an aluminum alloy high in silicon, which now is ready for issue. Standard turnings have been analyzed carefully by a number of experienced chemists representing the different interests. Elements which are at present standardized are as follow: Silicon 12.74 per cent; iron 0.34 per cent; manganese 0.005 per cent; zinc 0.020 per cent; titanium 0.006 per cent; copper 0.010 per cent.

Standard figures for traces of other elements which are present may be issued and published subsequently.

The standard is issued in bottles containing 500 grams, 100 grams, and 50 grams, and each bottle is provided with a certificate showing the analyses of each chemist, together with an outline of the methods used. In particular, the methods for determining silicon will be of interest, as this element when present in quantity in aluminum alloys has presented some difficulty to analysts.

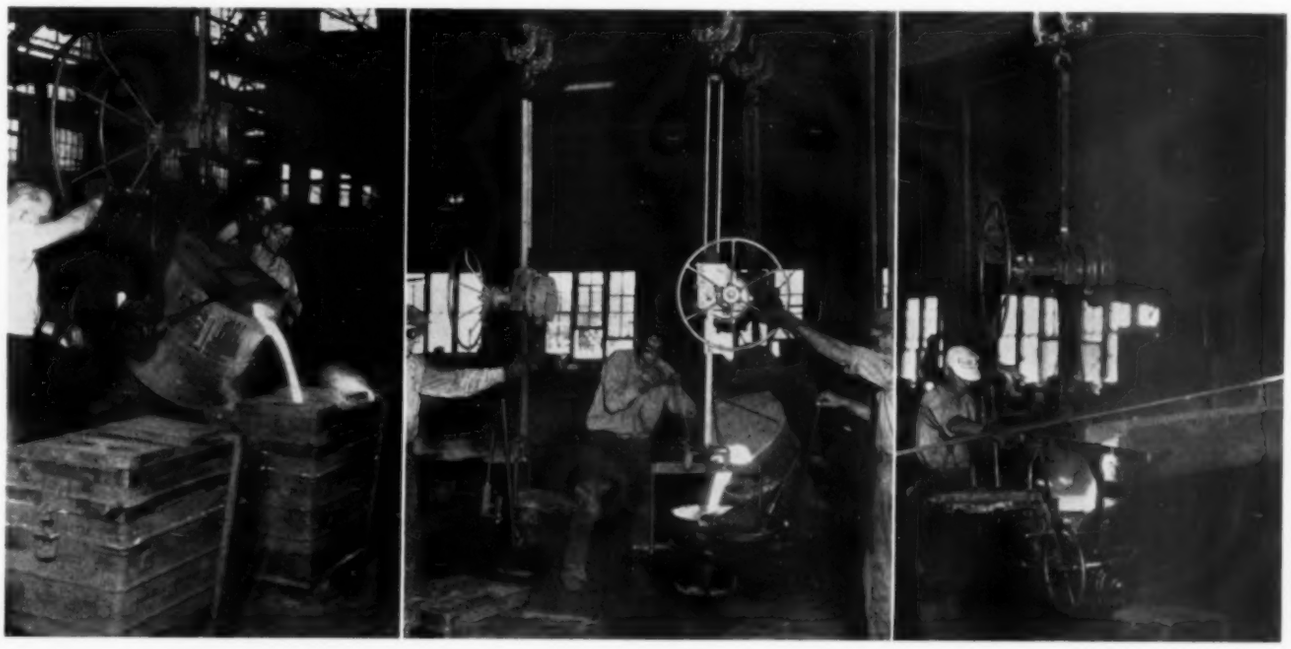
The standard may be obtained from Ridsdale & Co., 3, Wilson Street, Middlesbrough, Yorkshire, England.

Conveyor Belt Handles Hot Materials

B. F. Goodrich Co., Akron, O., recently has developed a new conveyor belt for handling hot materials. It is claimed that the flexing life of the new construction has been improved greatly, and that the belt cover is so constructed as to offer great resistance to abrasion after prolonged exposure to heat. Laboratory tests have shown the flexing life to be increased 31 per cent after aging tests.

Safety Switches

A line of explosion proof safety switches for hazardous locations has been introduced by Cutler-Hammer Inc., Twelfth and St. Paul avenue, Milwaukee. The line includes both single throw and double throw types in standard sizes up to 200 amperes.



Several views of the ladle showing the cover in position when pouring molds, and swung back for tapping the metal into the ladle

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" 1932 — 203
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Illinois Clay Products Company

Fire Clay and Fire Clay Flour

Fire Clay Brick

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JOLIET, ILL.

American Malleable Cast Iron

By H. A. Schwartz

This book is the first complete treatise on "black hearth" malleable iron ever published.

It covers the history of the malleable industry—its development, modern methods of manufacture, metallurgical principles involved and the properties and uses of American malleable cast iron. It also includes a detailed bibliography in which all the important books and articles published pertaining to malleable iron are listed and represents the only reference work available on the subject.

While written primarily for the producer and user of malleable castings, this book is also adapted to the needs of the technical student and the library.

"American Malleable Cast Iron" is the only book on malleable iron in print.

Price, Postpaid: $7.15 in U. S. and Canada; 35s. 9d. in other countries.

The Penton Publishing Company

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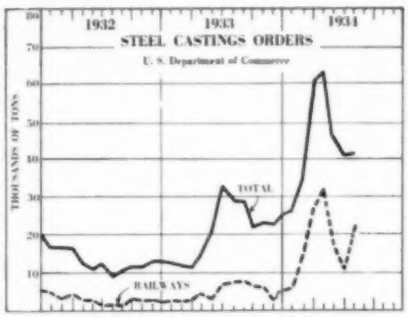
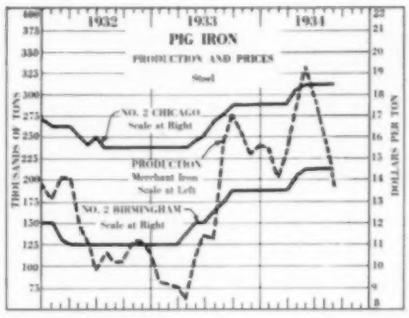
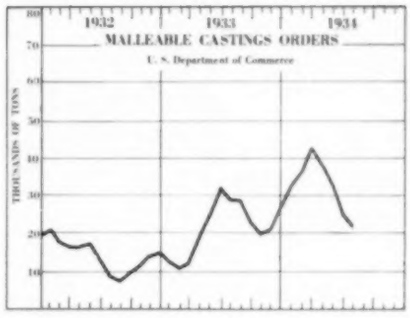






Foundry Activities

Reflect Industrial Trends

FAIRMOUNT FOUNDRY & ENGINEERING WORKS, Woonsocket, R. I., has been purchased by J. S. White of the J. S. White Co., Pawtucket, R. I., and Charles Miller of the Universal Winding Co., Providence, R. I. The company will continue operating under the same name.

* * *

Colebrookdale Iron Co. has changed its mail address from Pottstown, Pa. to Boyertown, Pa.

* * *

McKinnon Iron Works Co. plant, Ashtabula, O., recently was damaged by fire.

* * *

Revere Copper & Brass, Inc., New Bedford, Mass., will build a 1-story foundry addition.

* * *

John Westwick & Son Inc., Galena, Ill., recently resumed operations after being closed several months.

* * *

Property of the Machinists Foundry Co., Muncie, Ind., has been purchased by Ball Brothers Co. The Ball company will not operate a foundry.

* * *

Willard Foundry Co., O'Fallon, Ill., manufacturer of stoves, recently reopened after being closed for more than a year.

* * *

Chevrolet Motor Co., Janesville, Wis. has awarded a contract to T. S. Willis, Janesville, for the construction of a foundry addition and remodeling.

* * *

Mueller Brass Co., Port Huron, Mich., recently licensed the Aluminum Co. of America to manufacture aluminum fittings incorporating its proprietary features. License arrangements also have been completed with several other manufacturers.

* * *

Casting Service Corp., Laporte, Ind., has been incorporated with 1000 shares no par value to manufacture castings, forgings and machinery, by Leon W. Turner, Chester J. Jones and Loren R. Turner.

* * *

Index of orders for foundry equipment in July was 50.7 as compared with 70.4 in June and 48.6 in July, 1933. Index of shipments in July was 67.2, in June 64.3 and in July, 1933, 38.3.

* * *

Superior Foundry Co., Columbia and Hershel streets, East Peoria, Ill., has been incorporated to engage in a general manufacturing and foundry business, by Charles Bucklar, Charles W. Bucklar and Kathryn Bucklar. Correspondent: Louis F. Gillespie, 508 Reisch building, Springfield, Ill.

* * *

Niagara Foundry Co., Niagara Falls, N. Y. has developed a method of treating iron and steel castings wherein it is claimed that the crystaline structure of the iron is controlled by magnetic means. Ellsworth B. Tuohey of that company has had charge of the development.

* * *

Muncie Malleable Foundry Co., Muncie, Ind., John G. Malnoski, general manager, may move its plant to Dearborn, Mich., though no announcement is made. Information is being collected as to freight rates and delivery of raw materials to that point. The company has been employing about 800 men, mainly on automotive castings.

* * *

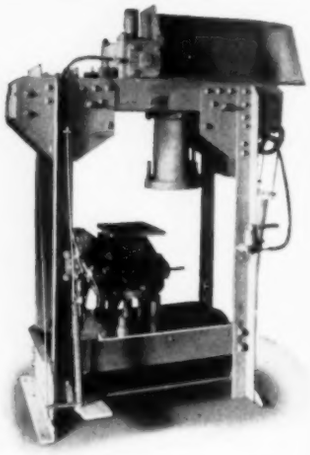
Production of steel and iron castings decreased in the Philadelphia district during July, according to a report of the Industrial Research department of the University of Pennsylvania. While the decrease in gray iron output was less than 1 per cent, steel castings production was off 16 per cent, following a steady climb for 8 months.

The meeting of the New England Foundrymen's association scheduled to have been held Sept. 12 has been postponed to Wednesday, Sept. 19.

RAW MATERIAL PRICES
Sept. 6, 1934

Iron			
No. 2 foundry, Valley			$18.50
No. 2 Southern, Birmingham			14.50
No. 2 foundry, Chicago			18.50
No. 2 foundry, Buffalo			18.50
Basic, Buffalo			17.50
Basic, Valley			18.00
Malleable, Chicago			18.50
Malleable, Buffalo			19.00
Charcoal iron, furnace			21.00
Coke			
Connellsville beehive premium	$ 5.10	to	$ 5.35
Wise county beehive coke	3.50	to	4.25
Detroit by-product coke			8.50
Scrap			
Heavy melting steel, Valley	$10.50	to	$11.00
Heavy melting steel, Pitts	10.50	to	11.00
Heavy melting steel, Chicago	8.75	to	9.25
Stove plate, Buffalo	8.00	to	8.50
Stove plate, Chicago	5.50	to	6.00
No. 1 cast, New York	6.25	to	6.50
No. 1 cast, Chicago	8.25	to	8.75
No. 1 cast, Pittsburgh	12.00	to	12.50
No. 1 cast, Philadelphia	11.00	to	11.50
No. 1 cast, Birmingham	9.00	to	9.50
Car wheels, iron, Pittsburgh	9.75	to	10.25
Car wheels, iron, Chicago	9.50	to	10.00
Railroad malleable, Chicago	9.25	to	9.75
Malleable, Buffalo	10.50	to	11.00
Nonferrous Metals			
			Cents per pound
Casting copper, refinery			8.75
Straits tin			51.45
Aluminum, No. 12, producers	18.00	to	22.00
Aluminum, No. 12 (Standard)			14.00
Lead, New York	3.70	to	3.75
Antimony, New York			8.62½
Nickel, electro			35.00
Zinc, East St. Louis, Ill.			4.20

Auto Malleables
Plumbing Goods
Stove Burners
Manifolds
Pipe Fittings
Vacuum Cleaners
Condulets
Carburetors
Specialties



Cores for the above castings are being made universally on our machines, resulting in greatly increased production and better cores.

We have a machine for your job.

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GRADES:
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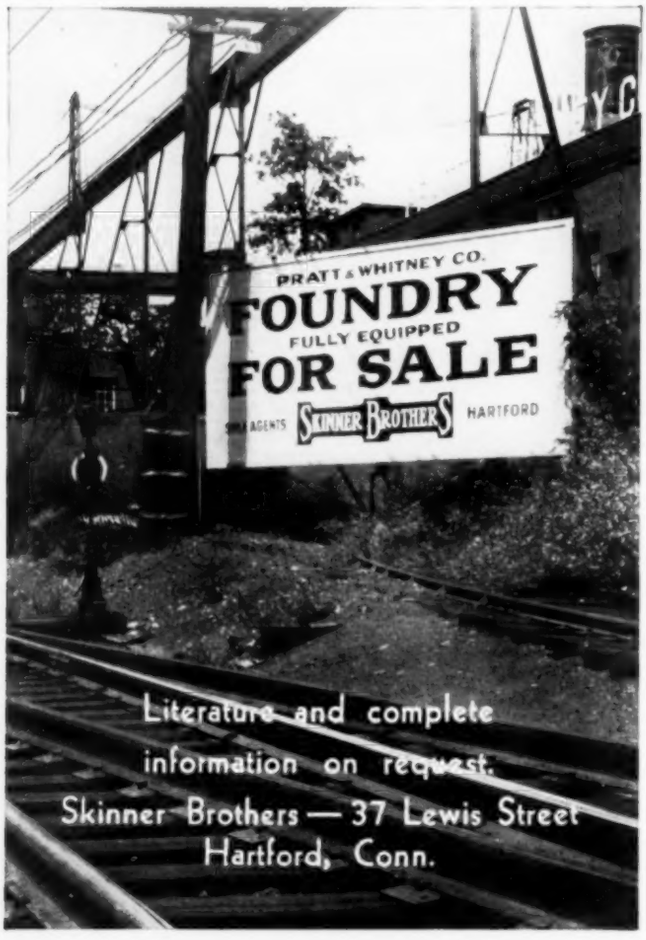

Literature and complete information on request.
Skinner Brothers — 37 Lewis Street
Hartford, Conn.

Foundrymen's Handbook

Second Edition

THIS second edition contains the most complete collection of formulas, tables, weights, specifications and information relating to foundry practice ever gathered together.

Invaluable to the foundryman, the pattern maker, the metallurgist and the executive. Gives, in most convenient form, the exact information you need to solve successfully any problems that may arise in your foundry operations.

Convenient arrangement of subject matter and thorough cross-indexing make it easy to locate information desired.

574 Pages, 6 x 9 inches
Price, Postpaid $6.15 in U.S. and Canada.

The Penton Publishing Co.
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New Trade Publications

SILICA FIRESAND—Cleveland Quarries Co., Builders Exchange building, Cleveland, recently has published bulletin No. 12 on its silica firesand for malleable furnace bottoms. Another bulletin of the company discusses silica stone used for cupola linings. Information is given on the methods of application.

RESPIRATORS—Mine Safety Appliances Co., Braddock, Thomas and Meade streets, Pittsburgh, has published a bulletin on a type of respirator which it is claimed features efficiency in dust stoppage with comfort to the wearer. Maintenance of the respirator requires renewal of filter disks as they become impregnated with dust, which is indicated by a gradual increase in breathing resistance.

CRANES—A new 16-page illustrated catalog of the Link-Belt Co., 910 South Michigan avenue, Chicago, presents information on its line of locomotive cranes. Tables of clearance dimensions and rated lifting capacities are given for machines for operation by either a gasoline, diesel, electric, or steam driven power unit. The book includes standard gage machines as well as cranes for operation on wide gage tracks.

BLASTING BARRELS—A line of blast cleaning barrels is described in a bulletin recently prepared by the Pangborn Corp., Hagerstown, Md. Illustrations show the features of construction of the various units, and exhibit a special quick loading device for use with the blast barrel.

PULVERIZERS — Whiting Corp., Harvey, Ill., has published a bulletin on its impact pulverizers used principally for pulverizing coal for firing metallurgical furnaces, ovens, kilns, boilers, etc. Mechanical features of the pulverizers are presented in detail, and illustrations show numerous installations of the unit.

COMPRESSORS—Features of a two-stage, air-cooled portable compressor are discussed in a recent bulletin of the Ingersoll-Rand Co., 11 Broadway, New York. The unit is built in five sizes ranging from 75 to 370 cubic feet per minute piston displacement and is supplied in a large variety of mountings. The publication is well illustrated with half-tones showing details of construction as well as numerous types of installations.

PRESSURE CONTROL — Leeds & Northrup Co., 4901 Stinton avenue, Philadelphia, has published a bulletin discussing its methods of maintaining pressure control on metallurgical and industrial furnaces. It is claimed that the application of automatic control will prevent losses due to infiltration of cold air by eliminating intervals between pressure fluctuations and corrective damper adjustments.

DRYING OVENS—Ajax Electrothermic Corp., Ajax Park, Trenton, N. J., has published a folder describing the installation of induction drying ovens in the plant of the Chrysler Corp. The oven is used for drying paint, and it is claimed that the equipment operates in such a way that the metal parts are heated by induction as they pass through the oven, therefore evaporating the volatile matter in the paint from the layers next to the metal out.

PUMPS—Duriron Co. Inc., Dayton, O., has prepared a new bulletin on centrifugal pumps for acids and alkalies. The bulletin presents details on the general construction of the pumps and discusses briefly the analysis of the different corrosion-resisting alloys from which the pumps are produced.

STARTERS — General Electric Co., Schenectady, N. Y., has prepared a bulletin on reduced-voltage starters of the auto-transformer type for use with squirrel-cage induction motors.

GLUE HEATERS—An electrically heated glue pot with automatic temperature control is described and illustrated in a folder recently published by the Sta-Warm Electric Co., Ravenna, O. The wall of the pot is heated by coils of resistant wire wrapped around the inner pot from top to bottom. A multiple circuit permits an even temperature control.

ELECTRIC GRINDERS—The Standard Electrical Tool Co., Cincinnati, O., recently has published a folder illustrated with various types of its line of electric grinders, polishers, buffers and drills. Each machine is described briefly.

MOTOR BASES—Rockwood Mfg. Co., Indianapolis, Ind., has issued two bulletins, one describing its ceiling drive base and the other its vertical drive base. This equipment is designed to provide and maintain correct belt tension during operation of the equipment.

BRONZE WELDING—Linde Air Products Co., 30 East Forty-second street, New York, has published a pamphlet entitled "The Progress of Bronze-Welding." The subject matter is arranged so that procedures for work on cast iron, malleable iron, steel and wrought iron, copper, brass and bronze are discussed. A special section is devoted to the building up of worn surfaces.

CORE OIL—Quandt Chemical Co., 374 Guerrero street, San Francisco, has published a booklet on its core oil. The text includes a discussion of advantages claimed in the use of the oil, and presents data on the method of application. The booklet also lists two other products, a core and mold wash for iron and nonferrous metals, and a core and mold wash for steel castings.

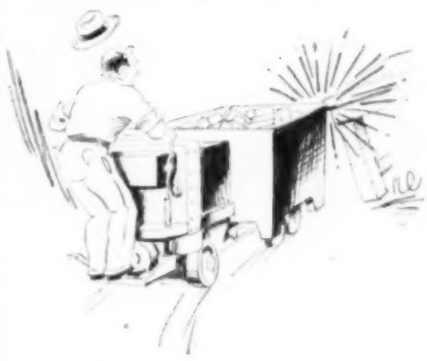
WELDING—A publication "Testing and Qualification of Welders" recently has been prepared by the Linde Air Products Co., 30 East Forty-second street, New York. The purpose of the booklet is to outline simple tests for measuring the ability of welders.

PYROMETERS—Illinois Testing Laboratories Inc., 141 West Austin, avenue, Chicago, has published a bulletin on its surface temperature pyrometers designed for temperature readings of surfaces, revolving rolls, molds, platens, plastics and for general research work.

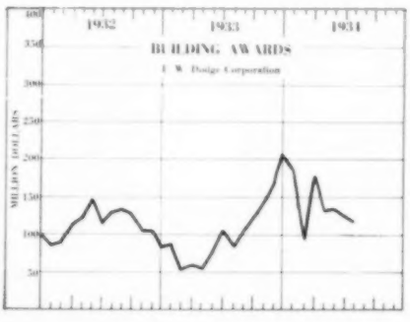
FIRE CLAY—Illinois Clay Products Co., Joliet, Ill., has published an interesting folder entitled "Story of the Goose Lake Fire Clay Deposit."

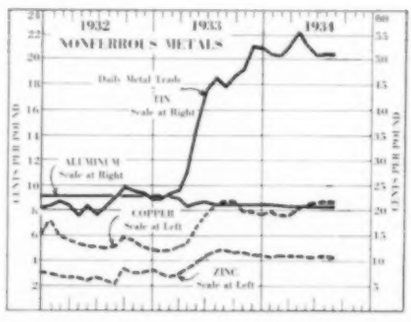
VALVES—Hauck Mfg. Co., 126-134 Tenth street, Brooklyn, N. Y., has issued a catalog on its line of micro regulating valves for use with oil burning equipment. Information is presented on the principle of construction and the performance of the unit. Data also are included on sizes and capacities.

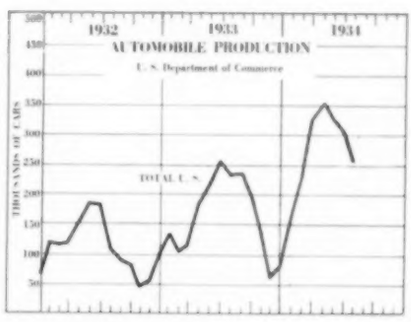
Faked Foundry Facts



Bench Rammer







Classified Ads

Help Wanted

WANTED

Salesman calling on foundries to handle a side line paying liberal commission, repeat order proposition shipped on trial. Radical money saving product used in all foundries. Address Box 988, THE FOUNDRY, Cleveland.

WANTED

Salesman calling on foundry and pattern shops to handle a side line offering liberal commission and no sales resistance. State territory covered and present line. Address Box 113, THE FOUNDRY, Cleveland.

SALESMEN

Sand Blast Nozzles

Hard Metal, Tungsten Carbide. Direct Sales Representatives interested in this article kindly communicate with Box 111, THE FOUNDRY, Cleveland.

SUPERINTENDENT WANTED

by a steel foundry, monthly capacity 3,000 pounds, electric and open-hearth furnaces. Address Box 999, THE FOUNDRY, Cleveland.

WANTED

Foreman for small electric steel foundry in Middle West. State age, experience and salary required. Address Box 105, THE FOUNDRY, Cleveland.

WANTED

Nonferrous foundry foreman for a general jobbing shop. Must be thoroughly familiar with all branches of the industry. Address Box 104, THE FOUNDRY, Cleveland.

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$2,500 to $25,000

This thoroughly organized advertising service of 24 years' recognized standing and reputation carries on preliminary negotiations for positions of the caliber indicated, through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If you have actually earned over $2,500, send only name and address for details.

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ATTENTION FOUNDRY OWNERS

Write or wire us for technically-trained practical foundry foremen, superintendent, production managers, chemists, metallurgists, core foremen, cost clerks, salesmen, patternmakers, melters (electric, open-hearth, converter and cupola.) No charge. Licensed Agency, McLAIN'S SYSTEM, INC., 804 Goldsmith Bldg., Milwaukee, Wis.

Positions Wanted

GRAY IRON FOREMAN

or superintendent on work from 1 lb. to 50 tons. Specialized heavy machine castings. Mix by analysis. Many years experience as molder foreman and superintendent. Address Box 567, THE FOUNDRY, Cleveland.

GRAY IRON FOREMAN

20 years practical experience on all classes of work, production and general jobbing. Well versed in coreroom practice, pattern construction and modern foundry methods. Address Box 593, THE FOUNDRY, Cleveland.

Positions Wanted

GRAY IRON AND SEMI-STEEL SUPERINTENDENT OR FOREMAN OPEN FOR ENGAGEMENT. BROAD EXPERIENCE. SMALL AND MEDIUM HEAVY CASTINGS. CAPABLE IN RIGGING AND PATTERN EQUIPMENT FOR MAXIMUM PRODUCTION. AGGRESSIVE LEADERSHIP. MIX BY ANALYSIS. ADDRESS BOX 452, THE FOUNDRY, CLEVELAND.

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Cupola expert. Knowledge electric furnace. Widely experienced on gray iron, semi-steel, nickel chrome. Automobile, Pipe and jobbing work. Sand control, molding. Address Box 457. THE FOUNDRY, Cleveland.

GRAY IRON SUPERINTENDENT

Efficient, up to the minute in all modern methods of foundry practice. Practical in coremaking, molding, cupola practice and patternmaking; expert rigger for high production at minimum cost. Can handle all classes of help successfully. 15 years executive. Age 42. Married. Address Box 754, THE FOUNDRY, Cleveland.

STEEL OR MALLEABLE FOUNDRY SUPERINTENDENT OR FOREMAN

Who can get results with 22 years of practical experience on all classes of castings, large and small. Address Box 906, THE FOUNDRY, Cleveland.

A-1 FOREMAN OF NONFERROUS FOUNDRY

Thoroughly practical in all branches, melting, molding, coremaking, jobbing and production work. Casting light and heavy, especially pressure casting. Valve and plumbing goods. Best of reference. Address Box 939, THE FOUNDRY, Cleveland.

PRACTICAL EXECUTIVE

in production of brass goods offers his services. Many years' experience in brass manufacture, all departments, and commercializing. Qualified to manage factory or branch or as general sales manager. Address Box 121, THE FOUNDRY, Cleveland.

GRAY-IRON AND SEMI-STEEL FOUNDRYman. Age 42. Practical and technically experienced. Acted successfully as foreman in all departments. Also as foundry superintendent. Mix by analysis. Address Box 115, THE FOUNDRY, Cleveland.

EMPLOYERS PLEASE NOTE!

When you are in need of a reliable man for immediate or future need, scan the position wanted ads in this section and reply to them. These advertisers will welcome the opportunity to set forth their qualifications.

If the man you want isn't listed here, a Help Wanted ad will bring quick results.

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Position Wanted advertisements; minimum ad 30 words, $1.50, additional words 5c each.

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Or superintendent thoroughly experienced in light and heavy work. Practical molder. Excellent handling of help. Seventeen years foreman. Desires position. Age 43. Address Box 884, THE FOUNDRY, Cleveland.

GENERAL MANAGER

with splendid record in managing and building up foundry, machinery and allied industries desires position requiring reliable qualifications and dependable service. Ability to economically and efficiently handle all office, sales, financial and creative activities unquestionably established by previous experience. Address Box 814, THE FOUNDRY, Cleveland.

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Large foundry preferred. Heavy or light castings. Specialized on high grade difficult castings. Up-to-date on equipment. Best of references. Will go any place. Address Box 916, THE FOUNDRY, Cleveland.

FOUNDRY SUPERINTENDENT

Wants to connect with progressive organization. Unusually broad experience and successful career. A skilled, practical foundryman with technical experience. Demonstrated ability in handling costs, stopping losses and production of quality castings. Grey iron, semi-steel and nickel alloy. Mix by analysis. Expert cupola practice. Light, medium and heavy work. Address Box 967, THE FOUNDRY, Cleveland.

ELECTRIC STEEL MELTER

Open for position. 22 years melting experience, acid, electric and open hearth. West or midwest preferred. References. Address Box 987, THE FOUNDRY, Cleveland.

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30 years experience in New England desires position as superintendent or manager. Training in drafting, estimating, machine production. Many acquaintances among buyers of castings. Salary secondary. A-1 references. Address Box 112, THE FOUNDRY, Cleveland.

STEEL AND IRON SUPERINTENDENT

with 14 years experience as foundry foreman in combined iron and steel shop. Experienced on carbon, manganese and alloy steels, gray iron, semi-steel, white iron, bronze and aluminum. Electric furnace and cupola practice. Blue print estimates. McLain graduate. Now employed. Address Box 109, THE FOUNDRY, Cleveland.

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British and American practice. Thirty years experience as molder, coremaker, foreman and superintendent. General jobbing, high test metals, also inexpensive abrasion resistant metal for mining machinery. Open shop. An interview may benefit both parties. Address Box 998, THE FOUNDRY, Cleveland.

FOUNDRY SUPERINTENDENT

Ferrous and non-ferrous. Highly skilled practical metallurgist. Wide experience. First class rigger for production. Has successful record as competent executive. Address Box 990, THE FOUNDRY, Cleveland.

POSITION WANTED ON ROAD OR IN charge of foundry, any location, by middle aged man. Have had long experience both jobbing foundries and selling. Address Box 986, THE FOUNDRY, Cleveland.

PRACTICAL STEEL FOUNDRYMAN

Wide experience as foreman, general superintendent and works manager, on railroad, crane, rolling mill and miscellaneous castings. Desire connection with reliable company. References. Address Box 930, THE FOUNDRY, Cleveland.